THE

PALÆONTOGRAPHICAL SOCIETY.

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Foraminifera
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THE

PALÆONTOGRAPHICAL SOCIETY.

Jones, Parker and Brady
Foraminifera of the Crag
Part IV

INSTITUTED MDCCCXLVII.

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MDCCCLXVI—MDCCCXCVII.

MONOGRAPH OF THE FORAMINIFERA OF THE CRAG.

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The Monograph of the Foraminifera of the Crag will be found in the Volumes of the Palæontographical Society issued for the years 1865, 1895, 1896, and 1897.

Cancel the Title-pages of Parts I, II, III, and IV in the Volumes for the years 1865, 1895, 1896, and 1897, and *substitute* the General Title-page in the Volume for the year 1897. *Cancel* pages i—vii in Volume for 1895, ix—xii in Volume for 1896, and xiii—xv in Volume for 1897, and *substitute* pages vii—xv (signatures B, C) in Volume for 1897.

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	V—VII	1895	October, 1895

A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

COMPRISING

PART I (1866), containing Pages i—vi, 1—72; Appendices I and II, and Plates I—IV.

By T. RUPERT JONES, W. K. PARKER, and H. B. BRADY.

PART II (1895), containing Pages 73—210 and Plates V, VI, VII.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

HON. MEM. GESELL. ISIS DRESDEN, SOC. BELG. MICROSC., AND SOC. GÉOL. PALÉONTOL. HYDROL. BRUX., GEOL. ASSOC. LOND., GEOL. SOCS. EDIN., GLASG., ROY. IRISH GEOL. SOC., AND ANTHROP. INST. LOND.; CORRESP. MEM. OF THE K.-K. GEOLOG. REICHSANST. VIENNA, AND ACAD. NAT. SCI. PHILAD., ETC.

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A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

INTRODUCTION.

In May, 1835, Mr. Edward Charlesworth read before the Geological Society of London a paper "On the Crag of part of Essex and Suffolk" ('Proceed. Geol. Soc.,' vol. ii, pp. 195-6), in which he mentioned that, "for his general information respecting the organic remains in the two beds" of the Crag, he was indebted to Mr. Searles Wood (then of Hasketon, near Woodbridge), whose collection of Crag fossils included "50 species of minute Cephalopods." These are the Foraminifera (at that time regarded generally as microscopic *Nautili*, &c.) which are brought forward in the present Monograph, to be illustrated, described, and put in comparison with other known Rhizopodal faunas, fossil as well as recent; the whole series having been liberally placed at our disposal.

Mr. Wood's original collection has been enlarged by the accumulation of specimens since 1835; but very few additional species of Foraminifera have occurred to him in his continued examination of the Crag of Sutton and elsewhere. Many of the forms met with by Mr. Wood have also been found by us in miscellaneous hand-specimens of Crag; and we have also some additional ones from these sources. We have taken about twenty forms (mostly common) from hand-specimens of Crag in which the *Cardita senilis* abounds, and nearly as many (mostly the same) from Crag with *Cyprina Islandica*; the former (*Cardita*) is very abundant at Sudbourne, as Mr. Wood informs us, and is not wanting at Ramsholt; the latter (*Cyprina*) prevails at both places in company with the *Cardita*. Some half dozen varieties we met with in a piece of Crag with *Ostrea*; but none of these are uncommon. Specimens of Polyzoan Crag have afforded thirty forms, mostly common in other varieties of the Crag. Specimens of Shelly Crag from Sudbourne, Aldborough, and Ged-

grave, have also yielded us a few Foraminifera, but, as in our other gatherings, with a paucity of individuals, and poverty of size and variety, that are strongly contrasted with the conditions under which Mr. Wood found his numerous and large specimens in the Crag of Sutton. On this subject Mr. Wood has remarked in letters to us, dated March 11th, and August 5th, 1863—"It is pretty nearly as you suspect; those fine specimens were from a special bed, which was particularly rich in those remains; and nearly the whole of what I then considered my fifty species were obtained from the Crag at one locality in the parish of Sutton. This spot, which formerly yielded to my examination specimens by hundreds (indeed, I may say by thousands), now scarcely supplies me with any. As this locality fails to furnish me with any but the commoner kinds of Shells and Foraminifera, I imagine that the rich community must have nestled in a protected nook, out of the reach of the moving waters, or in some quiet place under specially favourable conditions; and that the excavations in the deposit, as they have been extended westwards, have passed beyond this particular habitat. The bed at Sutton seems to have been a bank something like the 'Turbot-bank,' about 5 miles south of Larne (Antrim). The Crag at Sutton is somewhat isolated now, and separated from that at Ramsholt probably by denudation. At the latter place the White or Lower ('Coralline') Crag is overlain by the Red Crag; but at Sutton it has been excavated by denudation, and the Red Crag abuts against it, as has been pointed out by Lyell ('Mag. Nat. Hist.,' new ser., vol. iii, 1839, p. 314). Most of my specimens came from the east side of this hill, where the Crag deposit appears to have been sheltered; whilst on the west side the Crag is almost indurated, and its material comminuted." Mr. Wood adds that the true Polyzoan bank of the Crag (in which he found but few Foraminifera) is to be seen in the neighbourhood of Aldborough, Sudbourne, and Orford, overlying the bed wherein Shells, with occasional Actinozoa and Polyzoa, abound.

The geological relations of the several deposits of "Crag" in Norfolk, Suffolk, and Essex, have been treated of by Mr. Charlesworth in the 'Proceedings of the Geological Society,' 1835, vol. ii, p. 195, &c. ("On the Crag of part of Essex and Suffolk"); in the 'London and Edinb. Phil. Mag.' (Nos. 38 and 42, August and December, 1835), 3rd ser., vol. vii, pp. 81, 465, &c. ("Observations on the Crag-formation and its Organic Remains, &c."); and in the 'Report of the British Association' for 1836, 'Trans. Sect.,' p. 84 ("A notice of the Remains of Vertebrated Animals found in the Tertiary Beds of Norfolk and Suffolk"); also by Sir C. Lyell, 'Mag. Nat. Hist.,' 1839, new series, vol. iii, p. 313, &c. ("On the Relative Ages of the Tertiary Deposits, commonly called 'Crag,' in the Counties of Norfolk and Suffolk"); by Mr. S. V. Wood, jun., 'Annals Nat. Hist.,' March, 1864 ("On the Red Crag, and its relation to the Fluvio-marine Crag," &c.), also in his "Remarks in Explanation of the Map of the Upper Tertiaries of the Counties of Norfolk, Suffolk," &c., 1865; and by Mr. E. R. Lankester, 'Geol. Mag.,' 1865, vol. ii, pp. 103 & 149 ("On the Crags of Suffolk and Antwerp"). Of the three recognised divisions of the English Crag, the lowest has been known as the "Coralline

Crag" ever since Mr. Charlesworth so named it in 1835, on account of its abounding with little *coral-like* fossils, which, however, when duly studied, were found to be *Polyzoa*, Corals being exceedingly rare in it. "Polyzoan" or "Bryozoan Crag" ought, therefore, to take the place of this common misnomer; but "White Crag," "Lower Crag," and "Suffolk Crag," are still better names for this division, and are already in use. For general and special information on the Crag deposits, the reader can also refer with advantage to Lyell's 'Elements of Geology,' 6 edit., 1865, chap. xii; and to Phillips's 'Manual of Geology,' 1855, chap. xiii. In reading these, however, "Polyzoan" must be substituted for "Coralline" and "Zoophytic," with reference to the particular fossils and beds alluded to.

In 1843 Mr. S. V. Wood communicated forty-two names (some new and some after D'Orbigny) of Foraminifera found in the Crag to Mr. Morris's 'Catalogue of British Fossils.' In 1844 one of the Foraminifera of the Crag was described by Mr. Wood, in a list of the Zoophytes of that formation, published by him in the 'Mag. and Annals of Nat. Hist.,' vol. xiii, p. 21, as a sequel to the lists of the Mollusca of the Crag given by him in 1840-42 in the 'Mag. Ann. Nat. Hist.,' vols. vi and ix. These Mollusca have been fully elaborated by Mr. Wood in Monographs published by the Palæontographical Society: and the Monographs on the Cirripedia, the Echinodermata, and the Polyzoa, of the same formation, by Darwin, Forbes, and Busk, together with the account of the Corals of the Crag in the Monograph by Milne-Edwards and Haime, and of the Entomostraca in that by Rupert Jones, leave little to be done in the description of the Fossil Fauna of the Crag Formation; and the present Monograph on the Foraminifera is intended to lessen still further the remaining desiderata in that direction.

The collection of Foraminifera obtained by Mr. S. V. Wood from the Crag of Sutton comprises about eighty reputed species, or species and important varieties recorded binomially; and here we must remark that though, zoologically speaking, many of the recognised forms of Foraminifera are not *species*, but merely varieties, of different systematic values, yet, for the sake of convenience to zoologist and geologist, they have received and retain binomial appellations, that stand in the lists like specific names. The zoological value of these names is critically indicated in our papers on the "Nomenclature of Foraminifera," in the 'Annals and Magazine of Natural History' for June and November, 1859; February, March, April, June, July, and November, 1860; August and September, 1861; February, September, and December, 1863; March and July, 1865.

These Foraminifera from the Crag at Sutton are remarkable, for the most part, for size and abundance. The leading forms are *Miliola*, *Lagena*, *Nodosarina*, *Polymorphina*, *Textularia*, *Pulvinulina*, and *Nonionina*. As a fauna, they are best represented (in our collections) by dredgings from the Atlantic, south of the Scilly Isles, at from 50 to 70 fathoms, and from the Mediterranean on the north of Sicily, at 21 fathoms.

From all other parts of the Lowest or White Crag of Suffolk, as far as our collections serve, we have got a somewhat similar fauna, not only greatly reduced in number of

individuals and variety of forms, but composed of dwarfs in contrast with those of Sutton, except in the case of some of those that inhabit shallow water, as *Rotalia Beccarii* and *Polystomella crispa*, and even these are but feeble. Hence we may suppose that the Foraminiferal deposit at Sutton was formed either in deeper or in warmer water than other portions of the Crag were. Some of our sources of these less luxuriant growths are specimens of Crag full of *Cyprina* and *Cardita;* and as the former shell lives in the British seas, at from 5 to 80 fathoms—a depth similar to that affected by the Atlantic and Mediterranean groups of Foraminifera above alluded to, we must suppose that some deteriorating influence, either cold currents, floating ice, or cold climate, was at work locally, at least, in the Crag sea, excepting possibly the Sutton area.

Similar conditions are pointed out by the Bivalved Entomostraca of the Crag, the distribution of which will be treated of in an Appendix to this Monograph.

A group of Foraminifera, doubtlessly imperfect as a fauna, from a specimen of Crag with *Ostrea*, consisted of *Polymorphina Thouini*, *P. gutta*, *Textularia agglutinans*, *T. trochus*, and *Nonionina scapha*, all of middling size, and rather common. These also indicate water of moderate depth in a temperate climate. From the shelly Crag of Aldborough we have *Polymorphina lactea* (small and rare), *Rotalia Beccarii* (small and rare), *Polystomella striatopunctata* (middle-sized and common), and *Truncatulina lobatula* (very small, and rather common). These belong, probably, to the beds overlying the Lower Crag, and indicate shallow water. A similar group occurs at Bramerton and Thorpe, in the "Norwich" or "Fluvio-marine Crag," and also in the Uppermost Crag at Chillesford, which is continued, according to Mr. Searles Wood, jun., over the "Norwich Crag" at Aldborough, Bramerton, and Thorpe.

We have also to notice that among the Foraminifera of the Crag there are some that have been, in all probability, derived from older Tertiary beds; such are *Alveolina*, sp., and *Orbitoides Fanjasii*. *Amphistegina vulgaris*, *Nummulina planulata*, and *Operculina complanata* also attract attention as possibly having been washed out from Miocene and Eocene strata. None of these are common; and somewhat imperfect water-worn specimens are all the evidence we have of the two first-named.

Of the Foraminifera of the Upper or Red Crag, we have but a poor supply; indeed, it is not easy to determine in every instance whether we have a *native* or a *derived* fossil in a specimen from the Red Crag, as with this deposit are mixed fossils from the Lower or White Crag, and even from older Tertiary beds. (See Mr. S. V. Wood's memoir on this subject, 'Quart. Journ. Geol. Soc.,' vol. xv, p. 32, 1858.)

The Foraminifera of the Red Crag indicate a rather shallow sea-zone; they comprise a few common species of *Miliola*, *Polymorphina*, *Textularia*, *Truncatulina*, *Rotalia*, *Calcarina*, *Polystomella*, and *Nonionina;* not abundant as individuals, nor of large size; and are such as live at present in the British Seas, with the exception of *Calcarina*.

The Mammaliferous or Norwich Crag (Thorpe, Southwold, and Bramerton) yields a Rhizopodal fauna somewhat similar to that of the Red Crag.

The few kinds of Foraminifera yielded by the Chillesford Crag, a deposit regarded by Messrs. Wood and Prestwich ('Quart. Journ. Geol. Soc.,' vol. v, p. 350) as probably contemporaneous with the Crag of Norwich (Mammaliferous Crag), by Mr. S. Wood, jun.,[1] as subsequent to it, and by the Rev. O. Fisher[2] as being older than the Norwich Crag, indicate a rather shallow and cold sea, perhaps somewhat brackish too, as their probable habitat. They are *Polymorphina lactea*, *Bulimina elegans*, *Truncatulina lobatula*, *Rotalia Beccarii*, *Polystomella crispa*, and *P. striato-punctata*. Mr. Prestwich's observations (loc. cit., p. 351) on the probable influence of cold currents from the northern seas on the fossil fauna at Chillesford coincide with the above remarks.

Lastly, some Foraminifera collected by Mr. H. C. Sorby, F.R.S., from the Bridlington Crag[3] some years ago, and kindly placed at our disposal, have to be noticed. These comprise *Cornuspira*, *Miliola*, *Lagena*, *Dentalina*, *Cristellaria*, *Polymorphina*, *Cassidulina*, *Truncatulina*, *Polystomella*, and *Nonionina*, and are the most conspicuous of a probably more extensive fauna, nearly allied to that of the Suffolk Crag.

With regard to our treatment of the generic and specific grouping of Foraminifera in this Monograph, having repeatedly stated our views as to the necessity of allowing a wide margin for variation from any central type in determining species amongst the Protozoa, we need not again enter largely upon the subject. Every extension of research tends more and more to show that such characters as surface-markings, form of aperture, number of chambers, and direction of growth—peculiarities upon which not only species and genera, but even families, have been constituted—are individually of little value in forming an estimate of the essential characters of a *species* among Foraminifera. Neither need we repeat what we have before said on the expediency of retaining (with this reservation as to the significance to be attached to them) the binomial appellations that have been given to well-marked varieties, regarded by others as specific forms. We shall have occasion to use them in the course of the Monograph; and, as they will stand in the place of true specific names, we must refer our readers to the Table of Type-species, in the Appendix, for the alliances of these sub-species or varieties. By these remarks, we would not be thought to underrate the value of even trivial external features, such as those alluded to, for they are often of considerable significance both to the Zoologist and the Palæontologist; but only to caution those not practised in inves-

[1] See his paper mentioned at page ii.

[2] 'Quart. Journ. Geol. Soc.,' vol. xxii, p. 19, 1866.

[3] Mr. Bean wrote of the Bridlington Crag in 1835, 'Mag. Nat. Hist.,' vol. viii, p. 355; and Sir C. Lyell in 1839, 'Mag. Nat. Hist.,' new series, vol. iii, p. 313. See also Phillips's 'Geol. Yorkshire," 1829, vol. i, p. 69; and H. C. Sorby's paper on this Crag, in the 'Proceed. Geol. and Polytech. Soc.,' West Riding, Yorkshire, 1857-8, iii, p. 555. There is also a paper on the Bridlington Crag, by Dr. S. P. Woodward, in the 'Geol. Mag.,' 1864, vol. i, p. 49.

tigations connected with animals of very low organization, that they are not to be regarded as of the same importance as similar, but more permanent, marks would be in higher animals. The difficulty in determining species is enhanced by the fact, that, whilst on the one hand several distinct species may each present varieties so similar that they may be easily confounded, on the other hand the extreme variations in sub-specific forms may at first sight often appear of generic value.[1]

With these preliminary remarks we may proceed to the critical examination of the generic and specific forms which have been found in the Crag—endeavouring to distinguish the essential from the non-essential characters, the typical from the aberrant, the specific from individual modifications, and holding in view the same principles of investigation, the adoption of which has led, during recent years, to so great an increase of our knowledge of the group, at the hands of Williamson, Carpenter, Reuss, and others.

[1] We have sometimes thought that a passage in Whewell's 'Philosophy of the Inductive Sciences,' written, it is true, in reference to a far different subject, might have been written, *mutatis mutandis*, with almost equal truth of the nomenclature of the Foraminifera. Speaking of Haüy's nomenclature of the crystals of calcite, he says—"The want of uniformity in the origin and scheme of these denominations would be no valid objection to them if any general truth could be expressed by means of them; but the fact is, there is no definite distinction of these forms. They pass into each other by insensible gradations, and the optical and physical properties which they possess are common to all of them. And, as a mere enunciation of the laws of forms, this terminology is insufficient. Thus it does not at all convey the relation between the *bisalterne* and the *binoternaire*; the former being a combination of the *metastatique* with the *prismatique*; the latter of the *metastique* with the *contrastante*; again, the *contrastante*, the *mixte*, the *cuboide*, the *contractée*, the *dilatée*, all contain faces generated by a common law, the index being respectively altered, so as to be in these cases, 3, $\frac{2}{3}$, $\frac{4}{5}$, $\frac{9}{4}$, $\frac{5}{9}$; and this, which is the most important geometrical relation of these forms, is not at all recorded or indicated by the nomenclature."

NOTE.—A very valuable memoir on the English and Belgian Crag formations, by Mr. R. Godwin-Austen, F.R.S., has just appeared in the 'Quart. Journ. Geol. Soc. London,' vol. xxii, part 3 (No. 87), p. 229. &c. It is full of important facts and sound philosophic disquisitions.—*August*, 1866.

LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED.

IN PART I (1866).

NOTE.—The above are repeated, with modifications, in the later Parts, II, III, and IV,

IN PART II (1895).

IN PART III (1896).

LIST OF THE ILLUSTRATIONS IN THE MONOGRAPH (1866—1897).

PLATES I—IV (1866); V—VII (1895).

WOODCUTS IN PART II (1895).

WOODCUT IN PART III (1896).

WOODCUTS IN PART IV (1897).

LIST OF CORRECTIONS.

PART I (1866).

Page 15, last line but one in the synonyms, *instead of* p. 466 *read* p. 470.

„ 21, *insert*, after line 8 from the top, A good specimen of *Orbiculina numismalis* (one of the stages of growth of *O. adunca*) from the Crag of Ramsholt, collected by the late S. V. Wood, F.G.S., is in the Geological Society's Collection; also another, less perfect; both in coarse, sandy, light brown shell-grit.

„ 26, line 8 from bottom, *for* Schlotheim *read* Geinitz.

„ „ „ 7 „ „ Kirby „ Kirkby.

„ 32, 15th line of the synonyms, *instead of* Ib. *read* Ann. Mag. Nat. Hist., ser. 2.

„ 34, 5th „ „ *for* 307 *read* 317.

„ „ 6th „ „ „ p. 6 „ pp. 268, 269; and *for* pl. i *read* pl. v.

„ 40, line 2 from bottom, *for* Pliocene *read* Pleistocene.

„ 44, 2nd line of the synonyms, *for* 319 *read* 318.

„ „ 4th „ „ „ 40, 41 „ 90, 91.

„ 47, 48, 55, 59, 61, *for* Neuegeboren *read* Neugeboren.

„ 48, 52, 70, *for* Upper Trias of Chellaston *read* Lias of Leicestershire (?).

„ 53, line 20 from top, for *raphanius* read *raphanus*.

Footnote at page 61 *for* Marguline *read* Marginuline.

Page 64, line 8 from bottom, *for* Genus *read* Species.

„ 69 „ 2 „ of text, *for* Smith's *read* Smithsonian.

„ 70 „ 11 „ delete *granum* and its reference (Signor Fornasini has shown that this is a four-sided form).

PART II (1895).

Page 78, line 3 from bottom, in footnote, and p. 81, line 7 from bottom of the text, *for* Appendix *read* Table of Distribution, &c., at the end of the volume.

„ 93, in footnote, *for* p. 21 *read* p. 96.

„ 108, last line in list of synonyms, *for* p. 35 *read* p. 109.

„ 114, line 3 from top, *for* p. 33 *read* p. 107.

„ 119, 1st line, *for* 3 *a*, 3 *b*, *read* 4 *a*, 4 *b*.

„ 123, line 6 from top, for *Montagu* read *Walker and Jacob*.

„ 137 „ 11 from bottom, *for* 10 *read* 16.

„ 146 „ 16 „ *add* Mr. Millett has collected it from the Crag at Gomer, near Gedgrave.

„ 146 „ 15 „ *after* sp. nov. *add Jones*.

„ 153 „ 22 from top, *for* 19 *read* 10.

„ „ „ 34 „ *delete* this line.

„ 156 „ 8 „ *for* 1092 *read* 109^2.

„ 156 „ 24 „ *for* INÆQUILATERALIS *read* ÆQUILATERALIS.

„ 157, 1st line, TEXTULARIA GLOBULOSA, *Woodward and Thomas*, 1885 . . . . figs. 1—5, is T. GIBBOSA, and should be transferred to p. 153.

„ 159, 1st and 2nd lines, *read* Charente-Inf. Annales.

„ „ line 4 from top, *for* (Reud.) *read* (Rend.).

Page 159, last line but one from bottom, *for* Ak.-Wiss. *read* Ak. Wiss.
,, ,, ,, *for* 274 *read* 275, and *for* vii *read* vi.
,, 160 ,, *for* zone f *read* zone g.
,, 167, in the heading, *for* BOLIVINA PUNCTATA *read* VIRGULINA SCHREIBERSIANA.
,, 174, line 6 from top, *delete* dash and *add* OBLONGA before *Andreae.*
,, ,, ,, 8 ,, *delete* dash and *add* CRASSA before Egger.
,, 175, 1st line, *insert before* LAGENIDÆ, &c.—III. VITREA, HYALINA, vel PERFORATA.—Shell calcareous; perforate and hyaline in structure. (Those of the *Perforata* that in part take on an *arenaceous* investment are included in the *Arenacea.*)
,, 177, line 9 from bottom of text, *for* figs. 8 and 9, *add* note:—In the 'Rivista Ital. Paleont.,' June, 1896, Signor C. Fornasini, having examined the original specimens, states that Costa's fig. 8 is probably either a *Polymorphina* or an incipient *Marginulina,* and that Costa's fig. 9 is a *Glandulina.*
,, ,, ,, 10 from bottom, delete *Phialina oviformis* and reference (Fornasini finds it to refer to two different things).
,, 179 ,, 8 from top, and p. 182, line 13, for *Meriani* read *Mariani.*
,, 183 ,, 7 ,, *for* viii *read* xviii.
,, ,, ,, 12 from bottom, after *Soldani* add 1798.
,, 184 ,, 7 ,, *for* 38—40 *read* 38, 39.
,, ,, ,, 4 ,, *for* Pierzpuhl *read* Pietzpuhl.
,, 187 ,, 26 from top, for *Idem* read *Haeusler,* and *for* Ibid. *read* Neues Jahrb. for 1887, part 1.
,, ,, ,, 28 ,, *delete* this line.
,, ,, ,, 29 ,, *read* — SULCATA, *Brady,* 1888.
,, 189 ,, 12 from bottom, *for* 7, 10, *read* 7—10.
,, ,, ,, 11 ,, *for* 563 *read* 583.
,, 190 ,, 12 from top, *for* 327 *read* 326.
,, ,, ,, 14 ,, *after* SULCATA (pars) *add* var. SEMISTRIATA.
,, ,, ,, 15 ,, *after* 350 *for* pl. xvi, fig. 6, *read* pl. xiii, fig. 23.
,, ,, ,, 23 ,, *delete* this line and transpose SEMISTRIATA to the line below.
,, ,, ,, 29 ,, *for* Fenille *read* Feuille.
,, 191 ,, 9 from bottom, *add* and woodcut, fig. 20.
,, ,, ,, 4 ,, *for* 10 *read* 9.
,, 193 ,, 7 from top, *add* and woodcut, fig. 21.
,, 199 ,, 14 from bottom, *for* v *read* iii.
,, ,, ,, 8 ,, *read* 1889. Math. Természett. Értésitö, vol. vii, p. 68, pl. iii, fig. 4; and Math. u. Nat. Berichte aus Ungarn, vol. vii, 1890, pl. iii, fig. 4.
,, ,, ,, last line, *for* CATERINLOSA *read* CATENULOSA.
,, 201 ,, 16 from top, *delete* this line.
,, ,, ,, 17 ,, *read* LAGENA *before* VULGARIS, and for *Idem* read *O. Jones,* and *for* Ibid. *read* Tr. Linn. Soc., vol. xxx.
,, ,, ,, 18 ,, *for* p. 43 *read* figs. 42, 43.
,, 204 ,, 16 from bottom, *for* 82, *read* 81.

PART III (1896).

Page 221, line 9 from top, *for* Vignettes *read* Vignette 1.
,, 226 ,, 21 ,, Cornu Hammonis should not have been printed in capitals.

Page 226, in the foot-note, 2nd line from the bottom, *for* a *read* as.
,, 229, heading and line 11 from top, *for* LINARIS *read* LINEARIS.
,, 231, 1st line, after sp. nov. insert *Jones.*
,, 238, line 23 from bottom, *insert* NONIONINA.—*Römer, von Reuss, von Gümbel.*
,, 250 ,, 7 ,, in footnote, *for* laxum *read* laxus.
,, 253 ,, 2 ,, ,, *after* Zelanti, *add* Acireale.
,, 257 ,, 2 ,, in the text, *for* Neapol. *read* Neapel (without the full stop).
,, 271 ,, 5 ,, *after* BREVIS *add* nov., *Jones.*
,, 272, 1st line, *after* LINEATA *add* nov., *Jones.*
,, 275, 5th and 6th lines from the top to be *deleted.* Signor Fornasini states that figs. 16 and 17 are *Marginulinæ*, and that figs. 18 and 26 are not determinable.
,, ,, lines 17, 18, and 23 to be *deleted.*
,, 278, line 17 from top, *after* Appendix *add* I, Table, No. 59; and *for* Tables *read* Table.
,, 279 ,, 19 ,, *for* 4 *read* 2.
,, 286 ,, 5 ,, add *Seguenza.*
,, 288 ,, 4 ,, *for* 5 *read* 3; and *for* ROTALIDÆ *read* ROTALIIDÆ.
,, 290 ,, 10 ,, after nov. add *Jones.*
,, ,, ,, 11 from bottom, *for* ROTALINÆ *read* ROTALIINÆ.
,, 291, after the last line, *insert* — — *Chapman*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 719.
,, 293, line 6 from top, *for* Neapol *read* Neapel.
,, ,, after line 17 from top, *insert* — — *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 590, pl. xiii, figs. 11 *a—c.*
,, 296, line 14 from top, *insert* — — *Chapman*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 719.
,, 301 ,, 15 from bottom, *for* 4 *read* 3.
,, 306 ,, 18 ,, *after* Selsk. *add* Christiania.
,, 312 ,, 3 from top, *for* often *read* sometimes.
,, ,, ,, 5 ,, *delete* the comma *as well as* blunt.
,, ,, ,, 8 ,, ,, indefinite.
,, ,, ,, 12 and 13 from top, *for* the few *read* some of those.
,, ,, ,, 13 from top, *delete* (from Sutton and Sudbourne).

PART IV (1897).

Page 315, after line 16 from the top, *insert* HETEROLEPA, *Franzenau.*
,, ,, after line 5 from the bottom, *insert* HETEROLEPA GROSSERUGOSA, *Franzenau*, 1885. 'Természetrajzi Fuzetek' (Budapest), vol. ix, p. 93, pl. vii, fig. 2.
,, 329, line 11 from bottom, *for* Magt. Klein. *read* Magt. van het Kleine.
,, 333 ,, 10 from the top, *add* Mr. Millett has it from the St.-Erth beds.
,, 336 ,, 8 from the bottom, *for* 6 *read* 4.
,, 337, *insert* additional synonyms of NONIONINA:

ROTALINA, *Williamson.*
ROTALIA, *von Reuss.*
PULLENIA, *von Hantken.*
ANOMALINA (?), *Schwager.*
PULVINULINA, *Andreae.*

For ROBULINA add *Kübler and Zwingli.*
For POLYSTOMELLA add *Goës.*

,, 343, line 7 from bottom, *after* nov. insert *Jones.*

CORRECTIONS IN THE EXPLANATIONS OF THE PLATES I—IV, PART I (1866).

Plate I,	fig.	21,	should be	*Marginulina costata* (Batsch).
,,	,,	29—31,	should be	*Lagena lagenoides*, Williamson.
,,	,,	42, 43	,,	*Lagena acuticosta*, Reuss.
,,	,,	55—58	,,	*Polymorphina nodosaria*, Reuss.
,,	,,	61	,,	*Dimorphina tuberosa*, d'Orb.
,,	,,	66	,,	*Dimorphina compacta*, B., P., and J.
,,	,,	69	,,	*Polymorphina frondiformis*, S. V. Wood, Var. *lineata*, nov.
,,	,,	70—75	,,	tubulose forms chiefly of *Polymorphina gibba*, d'Orb.
,, II	,,	8—10	,,	*Truncatulina refulgens* (Montfort).
,,	,,	16—18	,,	*Rotalia calcar*, d'Orb.
,,	,,	22—24	,,	*Pulvinulina punctulata* (d'Orb.).
,,	,,	25—27	,,	*Pulvinulina repanda* (d'Orb.).
,,	,,	36, 37	,,	*Nonionina umbilicatula* (Montagu), thick variety.
,,	,,	44, 45	,,	*Nonionina scapha* (F. and M.), thick variety.
,,	,,	51, 52	,,	*Nummulites Boucheri* (?), de-la-Harpe.
,, III	,,	7—9	,,	*Textilaria sagittula*, Defrance.
,,	,,	19	,,	*Bigenerina nodosaria*, d'Orb.
,,	,,	20—22	,,	*Spirillina vivipara*, Ehrenb., Var. *complanata*, nov.
,,	,,	22	,,	*Radiolarian ?*
,,	,,	24	,,	*Dactyloporoid ?*
,,	,,	31—34	,,	*Miliolina*, not *Triloculina*.
,,	,,	35,36,41,42	,,	*Miliolina*, not *Quinqueloculina*.
,,	,,	45—47	,,	*Orbitolites complanatus*, Lamarck.
,,	,,	48, 49	,,	*Peneropolis* (*Dendritina*) *arbuscula* (d'Orb.).
,, IV	,,	1	,,	*Miliolina triangularis* (d'Orb.).
,,	,,	2	,,	*Miliolina bicornis* (W. and J.), Var. *Brongniartii* (d'Orb.).
,,	,,	3	,,	*Miliolina pulchella* (d'Orb.).
,,	,,	4	,,	*Miliolina Ferussacii* (d'Orb.).
,,	,,	7	,,	*Lagena reticulata* (Macgillivray).
,,	,,	8	,,	*Nodosaria proxima*, Silvestri.
,,	,,	18	,,	*Truncatulina Haidingeri* (d'Orb.).

A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

PART I.

CONTAINING

Pages i—vi; 1—72. Appendices I and II.

Plates I—IV.

BY

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MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

Class—RHIZOPODA.

Order—RETICULARIA (FORAMINIFERA).

Sub-order—*IMPERFORATA.*

Family—MILIOLIDA, *Carpenter.*

Genus—Cornuspira, *Schultze.*

Orbis, *Philippi* (in part).
Cornuspira, *Schultze* (in part).
Spirillina, *Williamson* (in part).
Soldania, *D'Orbigny* (in part).
Operculina, *Czjzek* and *Reuss* (in part).[1]
Cornuspira, *Parker* and *Jones*, *Carpenter*, *Reuss*, *Brady*.

General characters.—Shell, a flat spire, formed of a simple, non-segmented, and usually unconstricted tube, coiled on itself in a horizontal plane, usually cylindrical in the earlier portions of its growth, but becoming wider and flatter as it approaches maturity: white, opake, smooth, and free from ornamentation or surface-markings, except slight transverse ridges, apparently indicating its successive additions during growth. Aperture, terminal; oval or slit-like in shape, according to the extent of flattening which has taken place in the tube.

D'Orbigny, in the 'Annales des Sciences Naturelles,' vol. vii, p. 281, grouped a number of complanate Foraminifera under the generic name *Soldania.* The figures in Soldani's

[1] *Operculina cretacea,* Reuss, Verst. böhm. Kreid., p. 35, pl. 13, figs. 64 and 65 (*Cornuspira cretacea,* Reuss, Sitzungsb. K. Ak. Wien., vol. xl, p. 177, pl. 1, fig. 1), seems to be the same as D'Orbigny's *Operculina incerta,* Foram. Cuba, p. 49, pl. 6, figs. 16, 17; and this is a *Trochammina.*

'Testaceographia ac Zoophytographia,' to which reference is made by him, are unfortunately so diverse in character that no generic group can be founded upon them. Whilst some of the drawings are probably intended for specimens of the genus now under consideration, the others comprise *Cristellaria*, *Nummulina*, and *Planorbulina*; so that we are most unwillingly compelled to sacrifice a generic name dedicated to one of the earliest and most persevering students of Microzoa.

Soldania carinata, D'Orb. Ann. Sc. Nat., vol. vii, p. 281, No. 1; Sold., iv, App., p. 146, pl. 18, figs. P, Q (fossil) = *Cristellaria.*

— *spirorbis*, Id. Ibid., No. 2; Sold., Ibid., p. 140, pl. 4, figs. G, H (fossil) = *Nummulina exponens.*

— *nitida*, Id. Ibid., No. 3; Sold., ii, pl. 135, fig. 1 (fossil) = *Planorbulina* (*Planulina*) *Ariminensis.*

— *limia*, Id. Ibid., No. 4; Sold., i, p. 62, pl. 53, fig. C (fossil and recent) = *Cornuspira* (?).

— *orbicularis*, Id. Ibid., No. 5; Sold., i, p. 60, pl. 47, fig. H (recent) = *Cornuspira* (?). Both of these have more or less constricted whorls (if correctly drawn).

— *annulata*, Id. Ibid., No. 6; Sold., i, pl. 47, fig. C (recent) = *Serpula* (?).

1. Cornuspira foliacea, *Philippi*. Plate III, figs. 50, 51.

Orbis foliaceus,[1] *Philippi*, 1844. Enum. Moll. Sicil., vol. ii, p. 147, pl. 24, fig. 26.

Operculina striata, *Czjzek*, 1848. Haidinger's Naturw. Abhandl., vol. ii, p. 146, pl. 13, figs. 10, 11.

— plicata, *Id.*, 1848. Loc. cit., figs. 12, 13.

Cornuspira planorbis, *Schultze*, 1854. Org. Polyth., p. 40, pl. 2, fig. 21; Wiegmann's Archiv, 1860, p. 287; and Annals Nat. Hist., ser. 3, vol. vii, p. 306.

— , *Parker* and *Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 285.

Spirillina foliacea, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 91, pl. 7, figs. 199–201.

Cornuspira — *Parker* and *Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302 (table).

— — *Carpenter*, 1862. Introd. Foram., p. 68, pl. 5, fig. 16.

— — *Brady*, 1864. Linn. Soc. Trans., vol. xxiv, p. 472; 1865, Nat. Hist. Trans., Northumb. and Durham, vol. i, p. 92.

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[1] In appending to each typical and varietal form some of the names under which it has been mentioned by previous authors, we have not attempted a complete synonymy. Our rule has rather been to give reference in every case to the description and figures which have the right of priority in nomenclature, to a few of the earlier well-known standard works on general zoology, and to such more modern memoirs as are devoted to the Protozoa, and may be easily referred to by the student. Where the number of references has necessitated a selection, those have been preferred with which figures are given. With the subvarietal forms we have given still fewer references. The adoption of this course has been forced upon us by the length to which an exhaustive synonomy would extend. It may be said without doubt, that a complete list of authorities for some such species as the typical *Miliola seminulum* would occupy several pages, and would be of little use when finished, except as a curiosity of literature. The plan pursued by Mr. Jeffreys in his admirable work on Conchology,—that of giving only the key to the first description of the species, and a reference to its place in the last standard work on the subject, is an admirable one, but unfortunately not open to us, for want of the standard.

Characters.—Shell, convolute, planodiscoid, thin; the successive whorls becoming gradually, and often rapidly, wider; free from ornamentation, but marked with curved transverse lines of growth. Aperture, in full-grown specimens, a narrow slit, representing the open end of the coiled tube. Diameter $\frac{1}{30}$th to $\frac{1}{8}$th inch.

Cornuspira foliacea may be looked upon as the typical form of the genus. It is a beautiful, simple, little shell, inhabiting shallow seas, without much reference to latitude, and commonly attached by its flat surface to Algæ or Zoophytes. Owing to the slightly bi-concave contour, dead specimens, somewhat worn, frequently have the thin central portions broken away; and it is in this condition that our Crag specimens were found. In the northerly British Seas it is an uncommon species; but on our South coast it is more frequent, and specimens in Mr. Jeffreys' collection, dredged off Falmouth, are among the largest we know. It is common in the Arctic Seas, in the Mediterranean, in the South Atlantic, and on the Southern and Western shores of Australia. We cannot trace the species further back in geological time than the Lower Tertiary formations; it abounds in the *Calcaire grossier*, and may be found in almost every subsequent formation. Czjzek's specimens were from the Miocene beds near Vienna, where Reuss has also obtained some varieties (*C. angigyra* and *C. involvens*). The specimens from the Crag were collected by Mr. Searles Wood, at Sutton, where they were found in considerable numbers, and of large size.

2. Cornuspira involvens, *Reuss*. Plate III, figs. 52—54.

Operculina involvens, *Reuss*, 1849. Denks. Akad. Wien., vol. i, p. 370, pl. 45, fig. 20.
— — *Id.*, 1851. Zeits. Deutsch. Geol. Gesel., vol. iii, p. 73.
Cornuspira — *Id.*, 1863. Sitz. Akad. Wien., vol. xlviii, 1 Abth., p. 39, pl. 1, fig. 2.

Characters.—Shell, free, convoluted, discoidal, bi-concave; formed of a simple unconstricted, subcylindrical tube, wound on itself in one plane. Diameter about $\frac{1}{20}$th inch.

It is convenient to distinguish by a trivial name the thicker variety of *Cornuspira*, in which the tube, forming the spiral, retains to some extent the early, normal, cylindrical form, hollowed a little on its inner side, so that each successive whorl slightly embraces that preceding it.[1] On this ground we admit Professor Reuss's specific term, though we attach no more than subvarietal value to the particular characters possessed by the specimens described. Professor Reuss records the occurrence of this form in the Baden Beds of the Vienna Basin, and at Offenbach and Hermsdorf, Prussia.

[1] Professor Williamson is probably quite right in describing his figure 201, pl. 7, of his 'Monograph,' p. 91, as a young shell of *C. foliacea*, though it consists of "a few narrow rounded convolutions, of equal size," &c.

It is fossil also in New Zealand ('Novara-Expedition, Geol. Theil,' 2 Abtheil., p. 180).

Reuss describes and figures other *Cornuspiræ* (*C. angigyra*, 'Denks. Akad.,' Wien.,' vol. i, p. 370, pl. 46, fig. 19; *C. polygyra*, 'Sitz. Akad.,' vol. xlviii, p. 39, pl. 1, fig. 1; *C. Bornemanni*, l. c., fig. 3; *C. rugulosa*, 'Sitzungsb. Akad.,' vol. xviii, p. 222, pl. 1, fig. 1; *C. Reussi*, Bornemann, 'Denks. Akad.,' vol. xxv, p. 121, pl. 1, fig. 10), from the Tertiary beds of Germany. These, however, as well as *C. Archimedis* and *C. elliptica*, Stache, 'Novara-Expedition, Geol. Theil.,' 2 Abth., p. 180, pl. 22, figs. 1 and 2, can only be regarded (zoologically) as varieties of *C. foliacea*. Some, like *C. Hoernesi*, Karrer, may prove to be *Trochammina incerta*.

Genus—Miliola, *Lamarck*.

Serpula, *Linné*, *Walker and Jacobs*, *Adams*, *Maton* and *Rackett*.
Vermiculum, *Montagu*, *Fleming*, *Macgillivray*, *Thorpe*.
Miliolites, *Lamarck*, *Parkinson*.
Miliola, *Lamarck*, *Parkinson*, *Brown*, *Blainville*, *Schultze* (in part).
Miliolina, *Williamson* (in part).
Miliola, *Parker* and *Jones*, *Carpenter*, *Brady*, &c.

General characters.—Shell, oval or elliptical, composed of segments folded on each other from end to end, in one plane or more, each successive segment larger than the preceding one, and embracing the earlier segments to a greater or less extent. Shell, without true septation, but having a partial constriction in the angle at each change of the direction of growth. Colour, white, opake. Pseudopodial aperture variable in form, terminal.

Upon the mode and extent of the overlapping of the consecutive chambers depends the artificial division of the genus into the subgenera *Uniloculina*, *Biloculina*, *Triloculina* (and *Cruciloculina*), *Quinqueloculina*, and *Spiroloculina*.

Subgenus—Biloculina, *D'Orbigny*.

General characters.—Having only two chambers visible externally, each successive chamber entirely embracing the previous one on the same side.

1. Biloculina ringens, *Lamarck*. Plate III, figs. 26—28.

Miliolites ringens, *Lamarck*, 1804. Ann. Mus., vol. v, p. 351; vol. ix, pl. 17, fig. 1.
Pyrgo lævis, *Defrance*, 1824. Dict. Sc. Nat., vol. xxxii, p. 273; Atlas, pl. 88, fig. 2.
Biloculina bulloides, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 297, No. 1, pl. 16, figs. 1–4; Modèle No. 90.
— ringens, *Id.*, 1826. Ann. Sc. Nat., vol. vii, p. 297, No. 2.
— Canariensis, *Id.*, 1839. Foram. Canaries, p. 139, pl. 3, figs. 10–12.
— Isabelleana, *Id.*, 1839. For. Amér. Mér., p. 66, pl. 8, figs. 17–19.
— Peruviana, *Id.*, 1839. Foram. Amér. Mérid., p. 68, pl. 9, figs. 1–3 (and sub-varieties in pl. 8).
— subsphærica, *Id.*, 1839. Foram. Cuba, p. 162, pl. 8, figs. 25–27.
— bullata, *S. Wood*, 1843. Morris's Cat. Brit. Foss., p. 61.
— clypeata, *D'Orb.*, 1846. For. Fos. Vien., p. 263, pl. 15, figs. 19–21.
— simplex, *Id.*, 1846. Ibid., p. 264, pl. 15, figs. 25–27.
Triloculina bipartita (a badly grown *Biloculina*), *D'Orb.*, 1846. For. Fos. Vien., p. 275, pl. 17, figs. 1–3.
Biloculina ringens, *Sow.*, 1850. Dixon's Foss. Sussex, p. 162, pl. 9, fig. 9, *a*.
— turgida, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii, p. 85, pl. 7, fig. 55.
— ringens, *Parker* and *Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 298, pl. 10, figs. 28–33.
— — *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 79, pl. 6, figs. 169, 170; pl. 7, fig. 171.
— obesa, *Reuss*, 1865. Sitzungsb. Akad. Wien., vol. l, p. 450, pl. 5, fig. 7.

Characters.—Shell, oval or sub-spherical, ultimate chamber projecting beyond the penultimate all round, and having its margin more or less rounded. Aperture, at the end of the last segment; its shape and size variable, sometimes little more than a curved slit. Length $\frac{1}{20}$th to $\frac{1}{12}$th inch.

We may take this as a sub-type, comprising the numberless varieties of *Miliolæ* which show only two chambers externally, the ultimate and the penultimate. The form of the margin, the extent to which the edges of the chambers overlap, the greater or less globosity of the segments, and the shape of the aperture, differ in almost every specimen; and, although the general appearance of the shell is much affected by these variations, they are of no value as characters on which to found any real specific subdivision. It is, however, convenient to recognise some of the most important of the modifications of the ordinary plan of growth, though the very fact of the inconstancy of their characters precludes our viewing them as anything more than varieties; of these, perhaps, *Biloculina elongata*, D'Orb.,[1] *B. depressa*, D'Orb., *B. sphæra*, D'Orb.,[2] and *B. contraria*, D'Orb., are the most important.

[1] *Biloculina elongata*, D'Orb., 1826. Ann. Sc. Nat., vol. vii, p. 298, No. 4; *Parker* and *Jones*, Phil. Trans. 1865, p. 409, pl. 17, figs. 88, 90, 91.

[2] *B. sphæra*, D'Orb., 1839. Foram. Am. Mér., p. 66, pl. 8, figs. 13–6; Brady, 1864, Trans. Linn. Soc., vol. xxiv, p. 466, pl. 48, fig. 1.

Biloculina ringens is common in almost every sea, abounding all round our own islands. We find it, with most of the other *Miliolæ*, in Tertiary deposits, but not reaching further back than the Eocene beds of the Paris Basin. We find it rare in the Upper Crag, together with its variety *B. elongata;* but in the Sutton Crag it is large and common; and many of the specimens have somewhat narrow but ventricose chambers (fig. 28), tending towards the variety known as *B. contraria.*

Biloculina contraria, D'Orb., which is one of the extreme varietal forms of *B. ringens*, is figured in the 'For. Fos. Vien.,' p. 266, pl. 16, figs. 4—6; and by Brady, 'Trans. Linn. Soc.,' vol. xxiv, p. 246, pl. 48, fig. 2. Some of the sub-varieties, which, like Plate III, fig. 28, form passages between it and *B. ringens*, are—

Biloculina opposita, Deshayes, 1831. Coq. Caract. Tert., pp. 252, 259, pl. 3, figs. 8-10; Morris's Cat. Brit. Foss., 1843, p. 61; and 2nd edit., 1854, p. 61.
— *oblonga*, D'Orb., 1839. Foram. Cuba, p. 163, pl. 8, figs. 21–23.
— *Patagonica*, Id., 1839. Foram. Amér. Mér., p. 65, pl. 3, figs. 15–17.
— *irregularis*, Id., 1839. Ibid., p. 67, pl. 8, figs. 20, 21.
— *Bougainvillei*, Id., 1839. Ibid., figs. 22–24.
— *affinis*, Id., 1846. For. Fos. Vien., p. 265, pl. 16, figs. 1–3.

2. Biloculina depressa, *D'Orbigny.* Plate III, figs. 29, 30.

Biloculina depressa, *D'Orb.*, 1826. Modèle No. 91; Ann. Sc. Nat., vol. vii, p. 298, No. 1.
— carinata, *Id.*, 1839. For. Cuba, p. 148, pl. 8, fig. 24; pl. 9, figs. 1, 2.
— lunula, *Id.*, 1846. For. Fos. Vien., p. 264, pl. 15, figs. 22—24.
— umbonata, *Wood*, 1843. Morris's Catal. Brit. Foss., 1st edit., p. 61.
— amphiconica, *Reuss*, 1850. Denks. Akad. Wien., vol. i, p. 382, pl. 49, fig. 5.
— ringens, *var.* carinata, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 79, pl. 7, figs. 172—174.
Miliola (Biloculina) depressa, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. 17, figs. 89, *a*, 89, *b*.

Characters.—Similar to the typical form *B. ringens*, but differing in the more flattened shape of the chambers. Shell lenticular; margin sharp and carinate. Length, $\frac{1}{20}$th inch.

Biloculina depressa is found in company with the typical *B. ringens*, wherever the latter occurs. The only specimens we have from the Crag are those in Mr. Searles Wood's gatherings from Sutton.

Subgenus—TRILOCULINA, *D'Orbigny.*

General characters.—Having three chambers visible externally; either carinate or rounded.

1. TRILOCULINA TRICARINATA, *D'Orbigny.* Plate III, figs. 33, 34.

TRILOCULINA TRICARINATA, *D'Orb.*, 1826. Modèle No. 94; Ann. des Sc. Nat., vol. vii, p. 299, No. 7.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 466, pl. 48, fig. 3.
MILIOLA (TRILOCULINA) TRICARINATA, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. 15, fig. 40.

Characters.—Shell elliptical, angular, having the chambers produced at the margins so as to form three carinate edges. Aperture at the end of the outermost chamber. Length, $\frac{1}{10}$th inch.

Triloculina trigonula, Lamarck, being regarding as the best sub-type of the Triloculine *Miliolæ*, the sub-variety *T. tricarinata* bears the same relation to it that *Biloculina depressa* does to *B. ringens*; that is to say, it is the form which assumes sharp angular margins, instead of the rounded contour of the sub-type. Mr. Wood found it large and rare at Sutton. The true sub-typical form, though much more widely distributed than this variety, we have nowhere met with in the Crag.

Triloculina tricarinata can scarcely be called a common Foraminifer; for, though it occurs in localities far distant from each other, it is seldom found in any abundance. We have one or two specimens from the British Seas; in deeper water and in more northerly latitudes small specimens are frequent; but perhaps it attains its maximum size and frequency on the Australian coast. Geologically, its occurrence is, so far as we know, confined to the Tertiary formations, commencing in the Eocene deposits of Grignon, in the Paris Basin.

2. TRILOCULINA (QUINQUELOCULINA) OBLONGA, *Montagu.* Plate III, figs. 31, 32.

VERMICULUM OBLONGUM, *Montagu*, 1803. Test. Brit., p. 522, pl. 14, fig. 9.
TRILOCULINA OBLONGA, *D'Orb.*, 1825. Modèle No. 95; Ann. Sc. Nat., vol. vii, p. 300, No. 16.
— — *Id.*, 1839. Foram. de Cuba, p. 175, pl. 10, figs. 3–5.

TRILOCULINA EBURNEA, *Id.*, 1839. For. Cuba, p. 180, pl. 10, figs. 21—23.
— MARTIANA, T. CHEMNITZIANA, T. NITIDA, *D'Orb.*, 1839. For. Canar., pl. 3, figs. 16—24.
— CONSOBRINA, *D'Orb.*, 1846. Foram. Foss. Vien., p. 277, pl. 17, figs. 10—12.
QUINQUELOCULINA MAYERIANA, *Id.*, 1846. For. Foss. Vien., p. 287, pl. 18, figs. 1—3.
TRILOCULINA MICRODON, *Reuss*, 1850. Denks. Akad. Wien., vol. i, p. 382, pl. 49, fig. 9.
— NITENS, *Id.*, 1850. Ibid., p. 383, pl. 109, fig. 10.
MILIOLINA SEMINULUM, *var.* OBLONGA, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 86, pl. 7, figs. 186, 187.
TRILOCULINA OBLONGA, *Parker* and *Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 300, pl. 10, fig. 37; 1859, ibid., ser. 3, vol. iv, p. 343; 1863, vol. xii, p. 437.
MILIOLA (TRILOCULINA) CONSOBRINA, *Egger*, 1857. Foram. Mioc.-Schicht., p. 10, pl. 2, figs. 7, 8.
TRILOCULINA OBLONGA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472.
MILIOLA (QUINQUELOCULINA) OBLONGA, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 411, pl. 15, figs. 34—41; pl. 17, 85, *a*, 85, *b*, 86, *a*, 86, *b*.

Characters.—Shell, elongated, compressed, margins of the chambers rounded. Length, $\frac{1}{15}$th inch.

It is of but little consequence whether we regard this feeble flattened *Miliola* as belonging to the Triloculine or the Quinqueloculine group. In the feeblest forms, which are perhaps the most distinct from the type, it is Triloculine; but examples may easily be found which would form a regular series, passing by insensible gradations to the fully developed *Quinqueloculina seminulum.* The Crag specimens are generally Triloculine; those in Mr. Searles Wood's collection from Sutton are singularly fine; from the Crag with *Cardita senilis* (Gedgrave) we have but one or two small examples. In Mr. Sorby's gatherings from the Bridlington Crag the specimens are numerous, but not so large as those from Sutton.

Triloculina oblonga is found in shallow water, associated with other *Miliolæ,* in seas of every latitude; and minute specimens have been met with, even in abyssal depths, in the North Atlantic (2330 fathoms). We find it in most marine Tertiary clays, but it does not seem to date back further than the Eocene period.

The synonymy of *Miliola seminulum,* var. *oblonga,* is very extensive. This variety accompanies the better marked forms of *Miliola,* and has received very many appellations.

Subgenus—Quinqueloculina, *D'Orbigny.*

General character.—Five chambers visible externally.

1. Quinqueloculina seminulum, *Linné.* Plate III, figs. 35, 36.

Serpula seminulum, *Linné*, 1767. Syst. Nat., 12th ed., p. 1264, No. 791.
— ovalis, *Adams*, 1800. Trans. Linn. Soc., vol. v, p. 4, pl. 1, figs. 28—30.
Vermiculum intortum, *Montagu*, 1803, Test. Brit., p. 502.
Serpula seminulum, *Maton* and *Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 245.
Vermiculum intortum, *Fleming*, 1822. Mem. Wern. Soc., vol. iv, p. 564, pl. 15, fig. 3.
Quinqueloculina seminulum, *d'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 303, No. 44.
— meridionalis, *Id.*, 1839. For. Amér. Mér., p. 75, pl. 4, figs. 1—3, 10—13.
— Isabellei, *Id.*, 1839. Ibid., p. 74, pl. 4, figs. 17—19.
— Araucana, *Id.*, 1839. Ibid., p. 76, pl. 9, figs. 13—15.
— Magellanica, *Id.*, 1839. Ibid., p. 77, pl. g, figs. 19—21.
— pauperata, *Id.*, 1846. For. Fos. Vien., p. 286, pl. 17, figs. 22—24.
— Hauerina, *Id.*, 1846. Ibid., p. 286, pl. 17, figs. 25—27.
— Akneriana, *Id.*, 1846. Ibid., p. 290, pl. 18, figs. 16—21.
— impressa, *Reuss*, 1851. Zeitschr. Deutsch. Geol. Gesell., vol. viii, p. 87, pl. 7, fig. 59.[1]
— seminulum, *Parker* and *Jones*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 300, pl. 10, figs. 34—36.
Miliolina seminulum, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 85, pl. 7, figs. 183—185.
Quinqueloculina seminulum, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472.
Miliola (Quinqueloculina) seminulum, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 410, pl. 15, fig. 35*a*, 35*b*; pl. 17, fig. 87.

The foregoing are some selected examples from the synonymy of the best form of this species.

Characters.—Shell oblong, sub-compressed; margin rounded; segments ventricose. Colour, white to yellowish-brown. Length, $\frac{1}{15}$th inch.

The common typical robust *Miliola,* observed by Plancus, Gaultieri, Fabricius, Schröter, and indeed, by nearly all the early authors on marine organisms, was first properly described by Linné, in the tenth edition of the 'Systema Naturæ' (1758), under the name of *Serpula seminulum.* There are perhaps few members of the animal kingdom which have so often received the attention of naturalists, or that have been named and

[1] Figs. 56, 57, 58, of the same plate, seem to be more globose forms of *Q. seminulum.*

re-named so frequently as the little shell now under notice. We may look upon this as the true specific type to which the whole of the varieties of the *Miliolæ* belong, although for convenience we confine the use of the name to the particular form of shell indicated by the general characters above given. As might be supposed, its distribution is world-wide —scarcely a sample of sea-sand, either dredged or littoral, from any quarter of the globe, can be examined without finding specimens of it. In the Crag deposits we have it, in Mr. Searles Wood's collection, from Sutton, very large and common; from Gedgrave and Sudbourne; and from the Red Crag of Essex. From the Bridlington Crag we have many specimens, for which we are indebted to Mr. H. C. Sorby. *Quinqueloculina seminulum* is common in the Grignon Beds of the Paris Basin, and in many subsequent Tertiary strata. Varieties of *Q. seminulum* occur also in the Cretaceous deposits.

2. Quinqueloculina triangularis, *D'Orbigny.* Plate IV, fig. 1.

Quinqueloculina triangularis, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 302, No. 34.
— — *Id.*, 1846. For. Foss. Vien., p. 288, pl. 18, figs. 7—9.
Miliola (Quinqueloculina) seminulum, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 410, pl. 15, figs. 35*a*, 35*b*.

Characters.—Shell oval, convex; end-view more or less triangular. Colour, white to yellowish-brown. Length, $\frac{1}{15}$th inch.

A few large angular Quinqueloculine *Miliolæ* occurring in the Lower Crag of Sutton, together with some smaller specimens from the "Crag with Polyzoa," and others from the Bridlington Crag, seem to claim separation from the typical form, and may be taken together conveniently, with D'Orbigny's name *triangularis*, as a sub-varietal designation.

They present the nearest approach we have in the Quinqueloculine series to the angular condition represented by *Biloculina depressa* and *Triloculina tricarinata*, in their respective subgenera, although the margins of the chambers present somewhat softened angles, rather than any prolongation into carinæ. *Miliolæ* with these characters are to be found in the Mediterranean, the Red Sea, the South Atlantic, the Pacific, and the Indian Oceans, and, as fossils, in the Tertiary clays of the North of Italy, and the Vienna Basin. In some of these localities they appear to take the place of the typical *Miliola* (*Quinqueloculina*) *seminulum*.

Quinqueloculina semiplana, Reuss, 'Zeitsch. Deutsch. Geol. Ges.,' vol. vii, p. 275, pl. 10, fig. 1 (from the Chalk of Mecklenburg), can scarcely be distinguished from *Q. triangularis.*

The difficulty of drawing definite lines among the varieties and sub-varieties of *Miliolæ* will be readily realised, if we endeavour to work out the synonymy of such *Quinqueloculinæ* as are typified by *Q. triangularis;* D'Orbigny's *Q. Lamarckiana* ('For. Cuba,' pl. 11, figs. 14, 15); *Q. Auberiana* (Ibid., pl. 12, figs. 1—3); *Q. Buchiana* ('For. Fos.

Vien.,' pl. 18, figs. 10—12), and very many more noticed by D'Orbigny and others, are mere modifications of *Q. seminulum,* with more or less defined angles.

3. Quinqueloculina subrotunda, *Montagu.*

Serpula, *Walker,* 1784. Test. Min., p. 2, pl. 1, fig. 4.
Vermiculum subrotundum, *Montagu,* 1803. Test. Brit., Part 2, p. 521; *Fleming,* 1823, Mem. Wern. Soc., vol. iv., p. 565, pl. 15, fig. 5.
Quinqueloculina subrotunda, *D'Orb.,* 1826. Ann. Sc. Nat., vol. vii, p. 302, No. 36.
— — *Wood,* 1843. Morris's Cat. Brit. Foss., p. 63.
— seminulum, var. subrotunda, *Parker* and *Jones,* 1859. Ann. Nat. Hist., 3rd ser., vol. iv, pp. 336, 341, and 351.
Miliola (Quinqueloculina) subrotunda, *Id.,* 1865. Phil. Trans., vol. clv, p. 411, pl. 15, fig. 38.

Characters.—A small, roundish, bi-convex variety of *Quinqueloculina seminulum,* Linn.

Widely distributed in the Atlantic, if not in other seas, accompanying other *Miliolæ.* Mr. S. Wood found it in the Sutton Crag, and another example occurred to us; but the specimens have been lost.[1]

4. Quinqueloculina tenuis, *Czjzek.*

Quinqueloculina tenuis, *Czjzek,* 1848. Haid. Abhandl. Wiss., vol. ii, p. 149, pl. 13, figs. 31—34.
— — *Reuss,* 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii., pl. 7, fig. 60.
Miliola (Quinqueloculina) tenuis, *Parker* and *Jones,* 1865. Phil. Trans., vol. clv., p. 411, pl. 17, fig. 84.

Characters.—Nearly complanate, but often curved, thin, more or less unsymmetrical; presenting an extreme enfeeblement of *Q. seminulum,* Spiroloculine in aspect, and twisted on itself.

Q. tenuis is small and very rare in the Crag of Sudbourne (specimen lost). It lives in the Atlantic and Mediterranean, at considerable depths. It is fossil in some Tertiary beds of Germany, and in the Lias of England.

[1] We regret much that we have been compelled to make the remark "specimens lost," in connection with several species, one or two of them amongst the rarest of the Crag Foraminifera. We may explain, that quite recently, since the plates which are appended to this Monograph were engraved, we had picked out of our latest gatherings specimens of all the forms which had not been drawn, intending to make from them a fifth plate. The specimens were packed and sent by post, with a view to their being placed in the engraver's hands, but the parcel miscarried; and, notwithstanding the careful inquiries of the Post-Office authorities, which we are bound to acknowledge, it has not been heard of since. Except in the necessary omission of figures, and, in one or two cases, the want of details of measurement, the accuracy of the letter-press is not affected by the loss.

5. Quinqueloculina Ferussacii, *D'Orbigny*. Plate IV, fig. 4.

Quinqueloculina Ferussacii, *D'Orb.*, 1826. Modèle No. 32; Ann. Sc. Nat., vol. vii, p. 301, No. 18.
— Berthelotiana, *Id.*, 1839. Foram. Canaries, p. 142, pl. 3, figs. 25—27.
— inæqualis, *Id.*, 1839. Ibid., p. 142, pl. 3, figs. 28—30.
— bicostata, *Id.*, 1840. Foram. Cuba, p. 194, pl. 12, figs. 8—10.
— polygona, *Id.*, 1840. Ibid., p. 198, pl. 12, figs. 21—23.
— tricarinata, *Id.*, 1840. Ibid., p. 187, pl. 11, figs. 7—9.
— concava, *Reuss*, 1850. Denks. Akad. Wien., vol. i, pl. 51, fig. 2.
Miliolina bicornis, *var.* angulata, *Williamson*, 1858. Rec. For. Gt. Brit., p. 88, pl. 2, fig. 196.
Miliola (Quinqueloculina) Ferussacii, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 411, pl. 15, fig. 36.

Characters.—Chambers arranged as in the other *Quinqueloculinæ*. Surface of the shell traversed by a few coarse longitudinal ridges. Colour, white to dirty white, or yellowish. Length, $\frac{1}{18}$th inch.

The assemblage of forms which we associate under the general name *Q. Ferussacii* comprises specimens varying greatly, not only in the extent of the development and overlapping of the segments, and consequently in shape, but also in the amount and nature of the surface-ornamentation. D'Orbigny's Modèle No. 32, is a thick elongated *Miliola*, with a very few stout longitudinal ridges at irregular intervals, and at first sight will be thought a very different form from that which we figure. We shall therefore enumerate a few of the more important varieties which have been named by other observers, in order to show the great range of variation which exists amongst members of the group. In D'Orbigny's 'Cuba' Monograph we find *Quinqueloculina bicostata* and *Q. polygona*, both of which have almost exactly the characters of the "Model," and in *Q. tricarinata* we have what is evidently an anomalous specimen of the same variety, differing from the others chiefly in the confused setting-on of the ribs, which are partly in longitudinal lines, and partly reticulated or looped. In his South-American work there are interesting figures of two sub-varietal forms, both of which possess an ornamentation of fine striæ, in addition to the main angular ridges; one of these, *Q. flexuosa* (p. 73, pl. 4, figs. 4—6), has the striæ running in an oblique direction; in the other, *Q. Inca* (p. 75, pl. 4, figs. 20—22), they are parallel with the ridges. Some other slightly differentiated forms, tending in the direction of the Spiroloculine series, have been figured; and, were we to take certain of the so-called *Spiroloculinæ*, such as *Sp. cymbium* (D'Orb.), we should find it impossible to describe them by any zoological term which would not apply equally well to many specimens of the form now under consideration; indeed, the inosculation is so complete, as to render any specific (not to say generic) distinction impracticable, however necessary it may be for the sake of convenience to recognise the artificial division of the family. The single specimen (Plate IV, fig. 4) from the Crag is one of the out-spread

varieties, not far removed from the transitional forms above alluded to; the ridged marginal border being almost the only character connecting it with *Q. Ferussacii.*

It is very difficult, therefore, if not impossible, to define the limits of this variety, which passes into the true *Q. seminulum* on one hand, and into several varieties (of little value) on the other. The synonyms above given are merely a selection.

Stout-ribbed *Quinqueloculinæ* are not uncommon wherever the other *Miliolæ* exist, though they seldom occur in any great abundance; we find their shells also in fossiliferous Tertiary strata in the neighbourhoods of Paris and in the Vienna Basin. In the Crag we only note its occurrence at Sutton.

6. Quinqueloculina pulchella, *D'Orbigny.* Plate IV, fig. 3.

Quinqueloculina pulchella, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 303, No. 42; *Soldani*, Testac. ac. Zooph., vol. iv, p. 53, pl. 18, figs. *c* and *f.*

— Verneuiliana, Schreibersii, Josephiana, *Id.*, 1846. For. Foss. Vien., p. 296, pl. 19, figs. 19—27.

— pulchella, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 466, pl. 48, fig. 4.

Characters.—Shell traversed by several stout parallel longitudinal costæ. Segmen arranged as in the other *Quinqueloculinæ.* Colour white, dirty-white, or brownish. Length, $\frac{1}{15}$th inch.

The varying conditions of the surface of the shell in respect to texture and ornamentation are among the least of the secondary characters on which the artificial subdivision of the Milioline groups may be founded. These characters cannot boast any greater permanency than we have ascribed to those on which the larger divisions have been determined. The texture of the normally porcellanous Foraminiferal shells may, under altered circumstances, present every gradation from white and smooth to brown, rough, and purely arenaceous; and the surface-markings, which so many species exhibit, are seen in every degree of intensity, from delicate hair-like striæ and fine riblets, to deep sulcations and bar-like ribs. But, whilst it is impossible to draw any defined limit between these different forms of ornamentation, they are sufficiently striking in their external development to yield a ready means of dividing what would otherwise be a somewhat unwieldy and heterogeneous collection of forms.

The bold and strongly ribbed *Quinqueloculina pulchella* is not a common shell; and only a single specimen has occurred to us in our examination of the Foraminifera of the Crag. This specimen, from Sutton, is in Mr. Searles Wood's collection; and although it is broken and much worn, we have no hesitation in assigning it to this sub-species. On the British coast, *Q. pulchella* is a very rare form; but it is more frequent in the Mediterranean, and in tropical seas. It is occasionally found in the Tertiary fossiliferous deposits, but does not appear before the Grignon Beds of the Paris Basin.

7. QUINQUELOCULINA BRONGNIARTII, *D'Orbigny*. Plate III, figs. 41, 42; Plate IV, fig. 2.

POLLONTES VESICULARIS, *Montfort*, 1808. Conch. Syst., vol. i, p. 246.
ADELOSINA STRIATA (young *Q. Brongniartii*), *D'Orb.*, 1826. Modèle No. 18 ("young"), No. 97 ("adult"); Ann. Sc. Nat., vol. vii, p. 304, No. 2.
TRILOCULINA BRONGNIARTII, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 300, No. 23; *Soldani*, Testac. *Zooph.*, vol. iii, p. 229, pl. 154, figs. *bb*, *cc*, *dd*, *ee*, *ff*, *gg*.
— — *Id.*, 1839. Foram. Cuba, p. 176, pl. 10, figs. 6—8.
QUINQUELOCULINA GUANCHA, *Id.*, 1839. Foram. Canaries, p. 143, pl. 3, figs. 34—36.
— PARTSCHII, *Id.*, 1846. For. Fos. Vien., p. 293, pl. 19, figs. 4—5.
— BOUEANA, *Id.*, 1846. Ibid., p. 293, pl. 19, figs. 7—9.
— DUTEMPLEI, *Id.*, 1846. Ibid., p. 294, pl. 19, figs. 10—12.
— NUSSDORFIENSIS, *Id.*, 1846. Ibid., p. 295, pl. 19, figs. 13—15.
TRILOCULINA DICHOTOMA, *Reuss*, 1850. Denks. Akad. Wien., vol. i, p. 383, pl. 49, fig. 12.
QUINQUELOCULINA STRIOLATA, *Id.*, 1850. Ibid., vol. i, p. 385, pl. 50, fig. 10.
ADELOSINA CRETACEA, *Id.*, 1851. Haiding. Naturw. Abhandl., vol. iv, p. 46, pl. 5, fig. 15.
QUINQUELOCULINA BRONGNIARTII, *Parker* and *Jones*, 1860. Ann. Nat. Hist., ser. 3, vol. vi, p. 344.

Characters.—Shell having a surface-ornamentation of delicate, parallel, longitudinal striæ. Segments arranged as in the other Quinqueloculine *Miliolæ*. Colour white to yellowish. Length, $\frac{1}{16}$th to $\frac{1}{10}$th inch.

The finely striated *Miliolæ* included under this sub-varietal term may be found in every condition, from that approaching the common smooth unornamented shell, in which but a few short lines appear at the base of the penultimate chamber, as in Plate IV, fig. 2 (a condition represented to some extent in D'Orbigny's 'Modèles' Nos. 18 and 97), to that in which the whole of the surface is covered by delicate hair-like markings.

Mr. Wood's collection contains but a few specimens from Sutton, and we have not noticed the variety in the other Crag deposits. We have never seen examples having precisely the characters of *Q. Brongniartii* from our own coast, though we have a fair approach to it in some specimens of *Q. bicornis*, in which, though the marking is analogous, the shape of the shell is sufficiently distinct to justify separation. We find it occasionally in the Mediterranean, and in most shallow-water-dredgings from tropical seas. In the Tertiary clays of the North of Italy, in the Miocene of the Vienna Basin, and in the Eocene of the Paris Basin, it is also sparingly found.

Subgenus—Spiroloculina, *D'Orbigny.*

General characters.—Shell consisting of numerous segments arranged spirally on one plane. Segments scarcely embracing, so that the whole number are visible on both lateral faces.

1. Spiroloculina planulata, *Lamarck.* Plate III, figs. 37, 38.

Miliolites planulata, *Lam.*, 1805. Ann. Mus., vol. v, p. 352, No. 4.
Miliola — *Defr.*, 1824. Dict. Nat. Sc., xxi, p. 68.
Spiroloculina depressa, *D'Orb.*, 1826. Modèle No. 92. Ann. Sc. Nat., vol. vii, p. 298, No. 1; *Soldani*, Test. Zooph., vol. iii, p. 229, pl. 155, figs. *k k*.
— Badenensis, *Id.*, 1846. For. Foss. Vien., p. 270, pl. 16, figs. 13—15.
— dilatata, *Id.*, 1846. Ib., p. 271, pl. 16, figs. 16—18.
— excavata, *Id.*, 1846. Ib., figs. 19—21.
— concentrica, *S. Wood*, 1843. Morris's Cat. Brit. Foss., p. 64.
— depressa, *Jones*, 1854. Ib., 2nd edit., p. 43.
— — var. rotundata, *Williamson*, 1858. Rec. For. Gt. Brit., p. 82, pl. 7, fig. 178.
— planulata, *Parker* and *Jones*, 1860. Ann. N. Hist., 3rd ser., vol. v, p. 466; *P. J.* and *Brady*, 1865, ib., vol. xvi, p. 33.

Characters.—Shell elliptical or oblong, complanate; chambers all visible; margins more or less rounded. Length, $\frac{1}{9}$th inch.

This is the central, sub-typical form of the *Spiroloculinæ.* Amongst the fine bold specimens belonging to this group there is less variation from the normal condition than in any other of the Milioline sub-genera. The chief deviations which we find are those arising from feeble growth, giving rise to an elongated starved condition of the shell; or, as a result of rapid development from very small central chamber, an extremely bi-concave form in the adult. There are also occasional irregularities in the contour of the shell, from the much curved or sigmoidal growth of the chambers, and from the hollowing of their lateral faces; but the absence of surface-marking from the entire group lessens the number of varieties requiring trivial names.

Spiroloculina planulata is common in the Sutton Crag, and the specimens obtained from that source are of good size and of coarse growth. From the Polyzoan Crag we have seen only a few small examples. Geologically, *Spiroloculinæ* appear amongst the

earliest of *Miliolæ*, if not the first of all in point of time. A feeble variety of the form now under consideration is found in the Lower Lias Clay of Warwickshire; and it occurs, associated with the other *Miliolæ*, in nearly if not quite all the Tertiary strata that yield Foraminifers.

It is a very common form at all depths in the British seas, and partakes of the cosmopolitan character of the other sub-typical forms of the family.

2. SPIROLOCULINA CANALICULATA, *D'Orbigny*. Plate III, figs. 39, 40.

SPIROLOCULINA CYMBIUM, *D'Orb.*, 1839. Foram. Canar., p. 140, pl. 3, figs. 5, 6.
— CANALICULATA, *Id.*, 1846. For. Foss. Vien., p. 269, pl. 16, figs. 10—12.
— LIMBATA, *Bornemann* (non *D'Orb.*), 1855. Zeitsch. Deutsch., Geol. Ges., vol. vii, p. 44, pl. 8, fig. 1; *Reuss*, 1863, Sitz. Akad. Wien., vol. xlviii, p. 64, pl. 8, fig. 89.
— DEPRESSA, et var. CYMBIUM, *Williamson*, 1858. Rec. For. Gt. Brit., p. 82, pl. 7, figs. 177, 179.
— CANALICULATA, *Parker* and *Jones*, 1862. App. Carpenter's Introd. For., p. 312, pl. 6, fig. 2.

Characters.—Segments arranged as in the other *Spiroloculinæ*. Lateral faces of the chambers concave, in extreme examples the peripheral margins bearing a groove due to the prominence of the marginal ridges. Length, $\frac{1}{12}$th inch.

We prefer retaining the trivial name used in D'Orbigny's Monograph on the Foraminifers of the "Vienna Basin," in preference to the earlier one employed in his work on the Foraminifera of the Canaries, inasmuch as the figures to which it is applied indicate a shell of medium growth, and therefore more typical in character, and a better representative of the little group to which both varieties pertain. The figured variety in the latter work, *Sp. cymbium*, is one of the feeble and perhaps transitional forms, concerning many of which it is difficult to say whether they belong to the Spiroloculine or the Quinqueloculine sub-types. In *Sp. canaliculata* each chamber is more or less bi-concave; and in its extreme development the marginal ridges become very prominent, producing a well-marked marginal groove on the peripheral edge of the shell.

In the Lower Crag of Sutton we have many large specimens; but we are not able to speak of its occurrence in the Crag of other localities. Recent specimens are not uncommon; indeed, it may be said to occur wherever Spiroloculine *Miliolæ* are found, whether in shallow seas, or in fossiliferous beds formed under similar circumstances.

Genus—Peneroplis, *De Montfort.*

Nautilus, ***Forskål, Spengler, Linné, Gmelin, Batsch, Fichtel*** **and** ***Moll.***
Spirolina and Cristellaria, ***Lamarck.***
Peneroplis, ***De Montfort, De Blainville, D'Orbigny, Carpenter,*** **&c.**

General characters.—Shell free, equilateral, regular, more or less nautiloid. Form very variable; lenticular, outspread, or crozier-shaped. Surface usually obliquely striated. Each convolution formed of numerous narrow undivided segments. The outer whorl embracing those within it, and in the complanate varieties almost concealing them. Apertures variable, either single (in young shells) or numerous and distinct, or else taking the form of one large dendritic orifice caused by the coalescing of a linear series of pores.

Subgenus—Dendritina, *D'Orbigny.*

General characters.—Shell nautiloid, lenticular, turgid. Pseudopodial aperture large, irregular, dendritic.

1. Dendritina arbuscula, *D'Orbigny.* Plate III, figs. 48, 49.

Dendritina arbuscula, *D'Orb.*, 1826. Modèle No. 21. Ann. de Sc. Nat., vol. vii, p. 285, No. 1, pl. 15, figs. 6, 7.
Peneroplis planatus (*F.* and *M.*), var., *Carpenter*, 1859. Phil. Trans., vol. cxlix, p. 9, pl. 2; Introd. For., p. 88, pl. 8.

Characters.—Shell nautiloid, turgid, thickened at the umbilicus, rounded more or less at the margin. Aperture a single large ramifying orifice, formed by the coalescence of numerous small pores, arranged either in a line or otherwise. Diameter, $\frac{1}{20}$th inch.

In speaking of the earlier authors who have studied the different forms of *Peneroplis* ('Ann. Nat. Hist.,' March, 1865), we have stated our views fully as to the value of the subdivision of the type into genera and species. (See also Carpenter's memoir, 'Phil. Trans.,' 1859, and his 'Introd. Foram.,' p. 84.) Notwithstanding the wide variations in general contour, and in the nature of the pseudopodial apertures which may be observed in different specimens, there can be no doubt that the whole constitute but one true species. At the same time we are able to divide them roughly, according to the nature of their divergence from the central type, into three or four groups, for which, as causing least confusion, we propose to keep the well-known and hitherto accepted names, giving to them a subgeneric place. Of these groups, that centering in *Peneroplis* (*Dendritina*)

arbuscula is one of the most interesting in a zoological point of view; and the careful study of its peculiarities has been one of the chief means of reducing to a proper level the exaggerated views held by M. D'Orbigny and others as to the value of the form and character of the pseudopodial apertures in the determination of species amongst the Rhizopods. Dr. Carpenter has entered very fully into this question ('Phil. Trans.,' 1859; and 'Introduction,' pp. 88—91), and all who have had the opportunity of examining large numbers of specimens will agree in his conclusions.

Dendritina Antillarum, D'Orb., 1839, 'Foram. Cuba,' p. 58, pl. 7, figs. 3—6; and *D. Hauerii, D. Juleana,* and *D. elegans,* D'Orb., 'For. Foss. Vien.,' p. 134, pl. 7, figs. 1—6, are but slightly modified forms, or rather variously conditioned individuals, of the nautiloid *Peneroplis* under consideration.

Dendritina arbuscula has not so wide a distribution as the other varieties of *Peneroplis,* and the specimens are generally smaller than those of the outspread varieties. It has its home in shallow seas in tropical latitudes; and it is abundant in some parts of the Adriatic and Mediterranean. In the Tertiary beds it is occasionally met with as low as the Miocene of Bordeaux, the Oligocene of Germany, and even the Eocene of the Paris Basin.

The specimen figured by us from the Crag is, we believe, unique, and has a somewhat worn appearance. It is either from Sudbourne or Gedgrave.

Subgenus—Spirolina cylindracea, *Lamarck.*

Spirolina (Spirolinites) cylindracea, *Lamarck,* 1804. Ann. Mus., vol. v, p. 245, No. 2; 1806, ibid., vol. viii, p. 388, pl. 62, fig. 15; 1816, Tabl. Enc. Méth., part 23, pl. 465, fig. 7 *a-c,* and pl. 466. fig. 2, *a, b*; 1822, Hist. Anim. s. Vert., vol. vii, p. 603, No. 2.

Spirula cylindracea, *Blainville,* 1824. Dict. Sc. N., vol. xxxii, p. 190; Malacol., p. 382, pl. 5, fig. 1.

Spirolina cylindracea, *D'Orb.,* 1826. Modèle, No. 24; Ann. Sc. Nat., vol. vii, p. 286, No. 1.

— (et Spirolinites) cylindracea, *Defr.,* 1827. Dict. Sc. Nat., vol. l, p. 298, pl. 13, fig. 1.

— clavata, *Crouch,* 1827. Illust. Introd. Lam. Conch, p. 40, pl. 20, fig. 8.

— cylindracea, *Bronn,* 1838. Leth. Geog., vol. ii, p. 1135, pl. 42, fig. 24.

— et peneroplis, var., *Carpenter,* 1859. Phil. Tr., vol. cxlix, pl. 2, fig. 11; 1862, Introd., p. 88, pl. 7, fig. 4.

Peneroplis planatus (F. and M.), var., *Parker* and *Jones,* 1859. Ann. Nat. Hist., ser. 3, vol. iii, p. 481; 1860, ibid., vol. v, p. 466.

— pertusus (Forsk.),[1] var., *Parker, Jones,* and *Brady,* 1865. Ibid., vol. xv, pp. 231, 232.

Spirolina cylindracea (Lam), *P. J.* and *B.,* 1865. Ibid., vol. xvi, p. 22.

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[1] The wide variation in character presented specimens referable to the Peneroplid type has caused

General characters.—Numerous short, subcylindrical chambers, forming a long linear shell, of variable dimensions, truncate at one end, and perforated with either a single (often dendritic) aperture, or with several pores; and at the other (first-formed) end curled into a little crook or knob: this, when small, is often broken off, leaving a tapering, awl-shaped, striated shell, delicate in shape and white in colour.

Sp. cylindracea is common in the Mediterranean, Red, and Indian Seas. We have it small and very rare from the Crag of Sudbourne (specimen lost).

much confusion in the nomenclature; and it will be useful here to point out some of the best-marked forms of *Peneroplis* and its varieties, in chronological order:—

1775. NAUTILUS PERTUSUS, *Forskål* (type: comprising broad and narrow varieties). *Peneroplis pertusus*, Forsk.
1781. — RECTUS, *Spengler* (including a variety of *Articulina*).
1785. — UMBILICATUS, *Linné* (flat, curled like a crozier-head). *Peneroplis umbilicatus*, Linn.
1785. — SEMILITUUS, *Linné* (flat, with crozier-head and short stem). *Peneroplis semilituus*, Linn.
1788. — LITUUS, *Gmelin* (long, slender, cylindric, with one end curled). *P.* (*Spirolina*) *lituus*, Gm.
1791. — (LITUUS) ARIETINUS, *Batsch* (narrow, flat, curled at end). *P. arietinus*, Batsch.
1791. — — ACICULARIS, *Id.* *P.* (*Spirolina*) *lituus*, Gm.
1803. — PLANATUS, *Fichtel* and *Moll.* (broad forms). *P. planatus*, F. and M.
1804. SPIROLINA (SPIROLINITES) DEPRESSA, *Lamarck* (two subvarietal forms; one nearly lenticular, *Dendritina?*). *P. pertusus*, Forsk.
1804. — — CYLINDRACEA, *Id.* (long, sub-cylindrical, with one end curled). *P.* (*Spirolina*) *cylindracea*, Lam.
1808. PENEROPLIS LANATUS, *Montfort.* *P. planatus*, F. and M.
1816. CRISTELLARIA PLANATA, CR. DILATATA, *Lamarck;* and 1822, CR. SQUAMULA, *Lam.* *P. planatus*, F. and M.
1826. DENDRITINA ARBUSCULA, *D'Orb.* (lenticular). *P.* (*Dendritina*) *arbuscula*, D'Orb.
1839. COSCINOSPIRA (SPIROLINA) HEMPRICHII, *Ehrenberg* (stout, cylindric, with boldly curved end). *P.* (*Spirolina*) *cylindracea*, Lam.

Although Forskål did not figure *P. pertusus*, yet there can be no mistake in regarding the following escription as especially belonging to it ('Descript. Anim. Itin. Orient.,' 1775, p. 125): "Having compressed whorls, transversely sulcated, and marked with slight longitudinal striæ; at the aperture perforated with pores. Colour snow-white. . . . . Whorls straight at the base [top], often dilated, sometimes linear; at the apex [earliest part] convolutely spiral." It was from Suez, Red Sea.

Genus—Orbiculina, *Lamarck.*

Nautilus, *Fichtel* and *Moll.*
Orbiculina, *Lamarck.*
Archaias, Helenis, and Ilotus, *De Montfort.*
Orbiculina, *Lamarck, De Blainville, D'Orbigny, Williamson, Carpenter,* &c.

General characters.—Shell complanate, ear-shaped, sub-orbicular, or discoidal, usually thickened at the umbilicus. In typical specimens the plan of growth is spiral, frequently changing to cyclical, especially in large specimens. Septal bands narrow; chambers usually divided into chamberlets. Pseudopodial apertures in one or more rows on the peripheral margin of the last chamber.

1. Orbiculina adunca, *Fichtel* and *Moll.* Plate III, fig. 44.

Nautilus aduncus (adult), *Fichtel* and *Moll,* 1803. Test. Microsc., p. 115, pl. 23, figs. *a—e.*
— orbiculus (middle-aged), *Id.,* 1803. Ib., p. 112, pl. 21, figs. *a—d.*
— angulatus (young), *Fichtel* and *Moll,* 1803. Ib., p. 113, pl. 22, figs. *a—e.*
Archaias spirans (= O. angulata), *Montfort,* 1808. Conchyl. Syst., p. 190.
Ilotes rotalitatus (= O. orbiculus), *Id.* Ib., p. 198.
Helenis spatosus (= O. adunca), *Id.* Ib., p. 194.
Orbiculina adunca, *Lamarck,* 1816. Tabl. Encycl. Méth., pt. 23, pl. 468, fig. 2.
— angulata, *Id.* Ib., fig. 3.
— nummata (=O. orbiculus), *Id.* Ib., fig. 1.
— numismalis — *Id.,* 1822. Anim. s. Vert., p. 609, No. 1.
— angulata, *Id.* Ib., No. 2.
— uncinata (= O. adunca), *Id.* Ib., No. 3.
— adunca
— angulata
— numismalis
— nummata } *De Blainville,* 1824. Dict. Sc. Nat., vol. xxxii; and Malacologie, pp. 373-375, *after Lamarck.*
— numismalis, *D'Orb.,* 1826. Modèle No. 20; Ann. Sc. Nat., vol. vii, p. 305, No. 1.
— — *Ehrenberg,* 1838. Abhand. Akad. Berlin., 1839, pl. 3, fig. 1.
— adunca, *D'Orb.,* 1840. Foram. Cuba, p. 64, pl. 8, figs. 8—16.
— — *Williamson,* 1851. Trans. Micr. Soc. Lond., 1st ser., vol. iii, p. 105.
— — *Carpenter,* 1856. Phil. Trans., vol. cxlvi, p. 547, pl. 28, figs. 1—22, and pl. 29, figs. 1—3.
— — *Parker* and *Jones,* 1860. Ann. Nat. Hist., 3rd ser., vol. v, p. 181.
— — *Carpenter,* 1862. Introd. Foram., p. 93, pl. 8, figs. 1—12.

Characters.—Shell ear-shaped, reniform, or orbicular, compressed, thickened at the umbilicus. Chambers arranged spirally, usually divided into chamberlets. Pseudopodial orifices in one or more rows on the peripheral edge of the last chamber. Surface of the chamber frequently marked by delicate parallel transverse riblets.

Diameter, $\frac{1}{30}$th to $\frac{1}{8}$th inch.

Orbiculina flourishes in warm seas, but seems to be very rare in the Mediterranean. It is sparingly found in some of the European Tertiaries. Only one specimen, small and reniform, has occurred to us from the Crag (Sutton?).

2. Orbiculina compressa, *D'Orbigny.* Plate III, fig. 43.

Orbiculina compressa, *D'Orb.*, 1840. Foram. Cuba, p. 66, pl. 8, figs. 4—7.
Orbitolites coscinodiscus, *S. Wood*, 1843. Morris's Cat. Brit. Foss., p. 42; 1844, Mag. N. Hist., vol. xiii, p. 21.
— (?) — *Id.* 1854. Morris's Cat. Brit. Foss., 2nd edit., p. 39.

Characters.—Shell complanate, discoidal. Earlier chambers arranged spirally, as in the type, later chambers cyclical. Chambers subdivided into chamberlets.

Diameter, $\frac{1}{5}$th inch.

Although in localities where *Orbiculinæ* are plentiful, specimens of a large size are often found retaining the spiral arrangement throughout their whole series of chambers, we more frequently find that those which attain the finest proportions have assumed an outspread discoidal form, in place of the ear-like or reniform shape, owing to the alteration in the plan of development before alluded to. When this change commences, as is often the case after a very few chambers have been formed, a thickening of the umbilicus is almost the only external character which will enable us to separate the specimens from those of the closely allied genus *Orbitolites*, and even this feature may be wanting. Microscopical examination of the central or umbilical portion of the disk usually yields a ready means of determining the affinities of doubtful specimens in the arrangement of the early chambers. *Orbiculina* has invariably a nucleus of spirally arranged segments, however large and outspread the finely grown specimen may be; whilst *Orbitolites*, commencing growth with one or two large chambers, is built up entirely of concentric bands, in even the smallest and most obscure examples.

Specimens of *O. compressa* were not rare in the Crag at Sutton some years ago, when worked at by Mr. Wood. The figured specimen is of large size, but somewhat worn and broken.

Mr. Wood, in his "Catalogue of the Zoophytes from the Crag," 'Mag. Nat. Hist.,' 1844, vol. xiii, p. 21, describes, under the name of *Orbitolites coscinodiscus*, some specimens of this Foraminifer obtained at Ramsholt and Sutton. It is there stated that

the cells differ in form and arrangement from those of *Orbitolites complanata*; but the general form of the shell suggested *Orbitolites* for its genus. *Orbiculina compressa* is indeed an isomorph of the well-known *O. complanata* (more properly *O. orbiculus*); and in some instances they are with difficulty separated.

In distribution this variety is associated with the typical species; wherever the latter occurs abundantly we see the tendency in the bolder specimens to take the characters assigned to *O. compressa.*

In the spiral form of *Orbiculina* we recognise the type of a series of large-sized discoid Foraminifera common in tropical seas. The great diversity in appearance presented by different mature specimens, and the alterations which take place from time to time in the mode of growth of the shell, caused considerable confusion amongst the earlier writers, and were the cause of much unnecessary division into "species." D'Orbigny, in his 'Tableau Méthodique,' and subsequently in the 'Cuba' Monograph, somewhat simplified the nomenclature, by uniting the species founded by Lamarck, De Montfort, and others, which were, in some cases, nothing else than the young, middle-aged, and adult of the same variety; but it was not until Professor Williamson, in 1851, published his researches on the minute structure of the shell that the correct relations of the forms was understood. No true specific difference exists between the specimens whose entire growth is on a flat spiral plan and those which ultimately assume a discoidal form by the alteration, after partial development, to a cyclical mode of increase; neither has any principle been found to account for this taking place. Another very variable character in the species is the condition of the chambers in regard to subdivision. In well-formed individuals each chamber is divided into chamberlets by transverse partitions; but we frequently find, especially in small or poor specimens, the chambers simple, and free from any partition or constriction. The surface of the shell normally exhibits a certain amount of surface-marking in the form of delicate parallel riblets, running in a transverse or oblique direction to the chambers, very similar to those of *Peneroplis*; but this, again, is by no means a constant character.

Genus—Orbitolites, *Lamarck.*

Nautilus, *Forskål.*
Orbitolites et Orbulites (parte), *Lamarck.*
Discolithus, *Fortis.*
Discolites, *Montfort.*
Marginopora, *Quoy* and *Gaimard.*
Sorites et Amphisorus, *Ehrenberg.*
Orbitolites, *Defrance, D'Orbigny, Carpenter, Parker* and *Jones,* &c.

General characters.—Shell a flat, circular disk, composed of one or more layers of concentric zones arranged around a central or primordial portion. Each zone or chamber subdivided by depressions in the shell wall (marked externally by surface furrows) into ovate or rectangular chambers, whose long diameter is in the direction of radii. Pseudopodial orifices situated in depressions on the lateral face of the peripheral chamber. Texture porcellanous, diaphanous.

1. Orbitolites orbiculus, *Forskål.* Plate III, figs. 45—47.

Umbilicus marinus, *Plancus,* 1744. Fab. Columnæ Lync. Phytobas. Addit. p. 136, pl. 38, fig. F.
Helicite et Opercule, *Guettard,* 1770. Mém., vol. iii, p. 434, pl. 13, figs. 30—32.
Nautilus orbiculus, *Forskål,* 1775. Descrip. Anim., p. 125, No. 66.
Orbitolites complanata, *Lamarck,* 1801. Syst. Anim. s. Vert., p. 376.
Discolithus X., *Fortis,* 1802. Mém. Hist. Nat., vol. ii, p. 111, pl. 3, figs. 4, 5.
Madreporite, *Deluc,* 1803. Journ. Phys., vol. lvi, p. 349, fig. 9.
Discolites concentricus, *Montfort,* 1808. Conchyl. Systém., vol. i, p. 186.
Orbitolites plana, *Brongniart* and *Cuvier,* 1808. Ossem. Foss., vol. ii, part 2, p. 270.
Orbulites marginalis, O. complanata, *Lamarck,* 1816. Anim. s. Vert., vol. ii, p. 196, Nos. 1, 2.
Orbitolites complanata, *Schweigger,* 1819. Beobacht., pl. 6, fig. 60.
Orbulites planulatus, *Blainville,* 1825. Dict. Sc. Nat., xxxvi, p. 294; Atlas Zooph., pl. 47, fig. 2; Actinologie, p. 441, pl. 72, fig. 2.
— marginalis, O. complanata, *Lamouroux,* 1821. Gen. Polyp., pp. 44, 45, pl. 73, figs. 13—16.
Orbitolites complanata, *Defrance,* 1825. Dict. Sc. Nat., xxxvi, p. 294.
— — *Bronn,* 1825. Syst. Urwelt. Pflanz., pl. 6, fig. 18; 1838, Leth. Geogn. pl. 35, fig. 22.
Sorites orbiculus, *Ehrenberg,* 1838. Berlin Trans. (1839), p. 112, pl. 3, fig. 2.
Amphisorus Hemprichii, *Ehrenberg,* 1838. Ib., p. 114, pl. 3, fig. 3.
Orbitolites complanata, O. elliptica, *Michelin,* 1840—45. Icon. Zooph., p. 167, pl. 46, fig. 4, and p. 277, pl. 61, fig. 11.
— — *Carpenter,* 1850. Quart. Journ. Geol. Soc., vol. vi, p. 30, pl. 6, fig. 23; pl. 7, figs. 24—30.
Orbiculina (Orbitolites) complanata, *Williamson,* 1851. Trans. Micr. Soc., vol. iii, p. 115, pl. 17, fig. 8; pl. 18, figs. 9—14.
Orbitolites complanatus, *Jones,* 1854. Morris's Cat. Brit. Foss., 2nd edit., p. 39.
— complanata, *Carpenter,* 1856. Phil. Trans., vol. cxlvi, p. 181, pls. 4—9; 1862, Introd. Foram., p. 105, pl. 9.
— — *Parker* and *Jones,* 1860. Ann. N. H., 3rd ser., vol. v, p. 291, &c.

Characters.—Shell circular, discoidal, flat, sometimes slightly bi-concave. Chambers consisting of narrow concentric bands, subdivided into chamberlets, which alternate, after the pattern of the *Spiral of Archimedes* (Haughton); surface marked by furrows, indicating the margins of the chamberlets. Shell composed of one (simple type) or several (complex

type) layers of chambers. Pseudopodial orifices situated in depressions on the lateral face of the external annular chamber. In the simple type, consisting of a single row of pores, there is one pore in each depression; in the complex type several rows, roughly corresponding to the number of layers of chambers. Diameter, $\frac{1}{12}$th inch to 1 inch.

As the variations from the typical form are so unimportant that subdivision is unnecessary, little need be added in respect to the species, not already given in the generic distinctions. Ehrenberg rightly referred his "*Sorites*" (a simple Orbitolite) to the *N. orbiculus*, of Forskål, whose description of it embraces also "*Amphisorus*" (complex in growth).

We have seen but one or two perfect specimens of *Orbitolites orbiculus* from the Crag (Sutton), and these have been imbedded in a hard matrix; but we have a few fragments separated from the rock. Our figure, Plate III, fig. 45, is taken from one of these fragments; and figures 46 and 47 illustrate the structure of the complex type, the one being a view of a portion of the edge of a specimen, showing the pseudopodial apertures; the other a vertical section, exhibiting the arrangement of the chambers, and their connection with each other.

The distribution of *Orbitolites* is almost confined to tropical latitudes, its range extending but little into the seas of the temperate zones. On the Australian shores, in the Indian Ocean, and in the Caribbean and Red Seas, it is, perhaps, most abundant. It exists in the Mediterranean. Fossil specimens are first found in the Maestricht Beds (*O. macropora*), and it reaches its maximum abundance in the *Calcaire grossier* of the Paris Basin. It is also found in the Bracklesham beds of Hampshire.

Alveolina, sp.

We may notice, in passing, the occurrence of one or two somewhat obscure specimens of *Alveolina* that we found in the Bryozoan Crag of Sudbourne. They have been unfortunately lost. These were so worn and devoid of character as scarcely to admit of specific determination; their presence, however, is of interest in connection with that of some other species which may have been derived from earlier Tertiary formations.

Family—LITUOLIDA, *Carpenter.*

Genus—Trochammina, *Parker* and *Jones.*

Webbina, *D'Orb.* (in part).
Rotalina, *Williamson* (in part).
Trochammina, *Parker* and *Jones, Reuss, Carpenter,* and *Brady.*
Ammodiscus, *Reuss* (?).

General characters.—Shell free or attached, very variable in form, consisting of one or many chambers. Texture arenaceous, the sandy constituents being held together by an ochreous cement, and not projecting above the surface, which is smooth. Polythalamous varieties have no proper septa; but the division into chambers is effected by constriction or infolding of the primary shell-wall.

The genus *Trochammina* differs from *Lituola* and the other arenaceous genera in the fact that, although its walls are chiefly built up of sand-grains, the particles are so incorporated in the calcareous cement that the surface of the shell is usually quite smooth. The solitary specimen, on the strength of which we accept *Trochammina* (*Webbina*) *irregularis* as a Crag species, is perhaps the most obscure form of the genus, and one which may be readily overlooked. It consists of a minute, subconical, tent-like, circular disc, growing parasitically on a flat bit of shell, and presenting no character to arrest the attention. Indeed, it is only by the knowledge gained in the examination of a large number of specimens that we are enabled to recognise its affinities, or even to satisfy ourselves of its belonging to the Foraminifera.

The simplest forms of *Trochammina* belong to a species (*T.* [*Webbina*] *irregularis,* D'Orb.) of which we have four varieties; and, since it is useful to have a "subgeneric" name distinguishing them from *Trochammina* proper (as is the case with so many other Foraminiferal groups), we have proposed ('Phil. Trans.,' 1865, p. 435) to retain D'Orbigny's term "*Webbina,*" applied by him to one of them, although first used for a few-chambered, uniserial, curved form of *Nubecularia rugosa* ('Foram. Canaries,' p. 126, pl. 1, figs. 16—18; and 'For. Foss. Vien.,' p. 74, pl. 21, figs. 11, 12).

1. *Webbina irregularis*, D'Orb., is adherent, moniliform, with more or less oval chambers, and varies in the relative length of its stoloniferous connecting tubes, in the number of its chambers, and in the straightness or curvature of their line of growth. Sometimes the stolons bifurcate, giving rise to a branching arrangement of a few chambers, common in strata of Cretaceous age, the Oxford Clay, &c. ('Quart. Journ. Geol. Soc.,' 1860, vol. xvi, p. 304; 'Carpenter's Introd. Foram.,' 1862, p. 141, pl. 11, figs. 8, 9).

2. *Webbina irregularis alternans,* P. & J., is adherent, and has the stolons issuing

from the chambers alternately from their sides as well as from their fronts, giving the shell a loosely Textularian character; its chambers are usually somewhat pyriform. In deep Mediterranean soundings; and in the Chalkmarl ('Q. J. G. S.,' *loc. cit.;* Carpenter's 'Introd.,' *loc. cit.*, fig. 10).

3. *Webbina irregularis clavata*, P. & J., is also a fixed form, and consists frequently of a single pyriform chamber, tubular at one end, and bearing a slightly margined and semioval aperture at the other. The tubular portion frequently gives off another tube and chamber, thus almost identifying itself with the bifurcating forms of *W. irregularis* proper. Common at great depths in the Mediterranean and South Atlantic ('Q. J. G. S.,' *loc. cit.*; Carpenter's 'Introd.,' *l. c.*, figs. 6, 7).

4. *Webbina irregularis hemisphærica*, nov. The specimen from the Crag described further on, barely separable from the last.

Trochammina (proper) is typified by *Tr. squamata*, P. & J., comprising five known varieties, which have spiral shells, more or less rotaliform in their growth.

1. The simpler of these forms, such as *Tr. squamata incerta* (*Operculina incerta*, D'Orb., 'For. Cuba,' p. 49, pl. 6, figs. 16, 17; *Spirillina arenacea*, Williamson, 'Monog. Brit. For.,' p. 93, pl. 7, fig. 203; *Ammodiscus* (?), Reuss, 'Sitz. Akad. Wien.,' 1861, vol. xliv, p. 365), consist of a long, spiral, undivided chamber, having the shape of the clear, perforated, discoidal *Spirillina vivipara*, Ehrenb., and of the white opaque *Cornuspira foliacea*, Phil. Living in the Atlantic; common at great depths in the Mediterranean. Fossil in the Gault, Lower Oolite, &c. (See 'Q. J. G. S.,' *l. c.;* and Carpenter's 'Introd.,' *l. c.*, fig. 2).

2. *Tr. squamata charoides*, P. & J., is a similar undivided tubular chamber vertically spiral, presenting a resemblance to the fruit of the *Chara*. Common in deep water; Mediterranean, Red Sea, and South Atlantic ('Q. J. G. S.,' *l. c.;* and Carpenter's 'Introd.,' *l. c.*, fig. 3).

3. The third variety, *Tr. squamata gordialis*, P. and J. ('Q. J. G. S.,' *l. c.;* Carpenter's 'Introd. For.,' *l. c.*, fig. 4; Parker and Jones, 'Phil. Trans.,' vol. clv, p. 408, pl. 15, fig. 32), has more than one chamber, the shell in the early stage being formed of a few spirally arranged, but variable chambers; and at a later period they are moulded on an undivided vermiform sarcode, sometimes slightly constricted at intervals, and either discoidal or irregularly elevated; often passing at nearly right angles over the primary disc, or forming sudden loops and twistings. It lives in the Red, Indian, and Arctic Seas. The "Permian" *Serpula pusilla* of Schlotheim (*Spirillina pusilla*, Jones; *Miliola* (?) *pusilla*, Kirby), and some forms of the Cretaceous (?) *Trochammina proteus* of Karrer, belong to the same. Indeed, the excellent figures of *T. proteus*, in Dr. Karrer's paper on the Old Vienna Sandstone, 'Sitz. Akad. Wien. Math.-Nat. Cl.,' vol. lii, 1 Abth., 1865, pl. 1, figs. 1—8, comprise modifications of *Tr. gordialis* (figs. 1, 2, 3, 8), *charoides* (fig. 4), *squamata* (fig. 6), and irregular *squamata*, or passage from lobulate *gordialis* to *squamata* (fig. 5). We may also remark that fig. 10 (named *Cornuspira Hoernesi*) is probably *Trochammina incerta*.

4. *Tr. squamata* (proper), P. and J., has the shell divided throughout into lunate and flattened chambers, several in a whorl, and regularly increasing with the progress of growth. It much resembles those flatter varieties of *Discorbina turbo* which are intermediate to *D. globularis* and *D. rosacea*, and it may easily be confounded with little, conical, scale-like varieties of *Valvulina triangularis*, but the latter never have more than three chambers in a whorl, and are more coarsely sandy. *Tr. squamata* lives both in the Arctic Ocean and the Mediterranean at considerable depths ('Quart. Journ. Geol. Soc.,' vol. xvi, p. 305; Carpenter's 'Introd.,' *l. c.*, fig. 1; Parker and Jones, 'Phil. Trans.,' vol. clv, p. 407, pl. 15, figs. 30, 31. It is well figured by Karrer (see above) from a fossil specimen).

5. *T. squamata inflata*, Montagu, sp., rotaliform, consisting of several (20) ventricose chambers, increasing rapidly in size, few (5) showing beneath. (See Williamson's 'Monograph Rec. Brit. For.,' 1857, p. 50, pl. 4, figs. 93, 94; 'Ann. N. H.,' 3rd ser., vol. iv, p. 347; and Carpenter's 'Introd. Foram.,' p. 141, pl. 11, fig. 5.) Common in the brackish estuarine pools on our north-east shore (see Brady, 'Nat. His. Trans. Northumberland and Durham,' vol. i, p. 95); and found very rarely in deeper water on the British Coast; also living on the shores of the Mediterranean, and in the depths of the Arctic and South Atlantic Oceans. It also occurs in a sub-fossil condition in the clay underlying the peat of the Lincolnshire and Cambridgeshire fens.

Subgenus—WEBBINA, *D'Orbigny*.

General characters.—Shell adherent, comprising one or more pyriform, oval, or round chambers, subarenaceous, smooth, dirty white, or of a deep rusty colour; and, when numerous, arranged in a single, irregular, moniliform line, often branched.

1. WEBBINA HEMISPHÆRICA, *nov.* Plate IV, fig. 5.

Characters.—Small, circular, subconical, monothalamous, like a low bell-tent, parasitic; recognisable only by its smooth but sandy shell, and general resemblance to the common forms of *Webbina irregularis*.

Diameter, $\frac{1}{50}$ inch.

One specimen only of this little parasitical *Trochammina* (*Webbina*) *irregularis*, var. *hemisphærica*, occurs among the Foraminifera from Sutton.

SUB-ORDER—*PERFORATA.*

FAMILY—LAGENIDA.

Genus—LAGENA, *Walker* and *Jacob.*[1]

SERPULA (LAGENA), *Walker* and *Jacob.*
VERMICULUM, *Montagu.*
SERPULA, *Maton* and *Rackett, Pennant, Turton.*
LAGENULA, *De Montfort, Fleming, Macgillivray, Thorpe.*
OOLINA, *D'Orbigny, Reuss, Bronn, Egger, Terquem, Bornemann, Costa.*
MILIOLA, CENCHRIDIUM, *Ehrenberg.*
ENTOSOLENIA, *Ehrenberg, Williamson.*
OVULINA, *Ehrenberg, Bornemann, Seguenza.*
APIOPTERINA (parte), *Zborezewski.*
LAGENA, *Williamson, Morris, Parker* and *Jones, Carpenter, Reuss, Brady.*
FISSURINA, *Reuss, Bronn, Egger, Seguenza.*
AMPHORINA, *D'Orbigny, Costa, Seguenza.*
AMYGDALINA, PHIALINA, *Costa, Seguenza.*
TETRAGONULINA, TRIGONULINA, OBLIQUINA, *Seguenza.*

General characters.—Shell one-chambered, free, oval, oblong, or fusiform, and subject

[1] We append to the generic name *Lagena*, and to a number of the specific forms, the initials W. & J. (*Walker* and *Jacob*), believing this to be the nearest approach to correctness we can make, though some authors have, with almost equal reason, assigned the same species to the authority of Walker and Boys, and others to Walker. The 'Testacea Minuta Rariora' is stated on its title-page to relate to "minute and rare shells lately discovered in the sand of the sea-shore, near Sandwich, by William Boys, F.S.A., considerably augmented, and all their figures drawn by George Walker," the latter of whom is spoken of in the same page as the author; and his name also appears alone in the dedication. Prof. Williamson, in his 'Monograph,' has given his reasons why the species may be regarded as *Walker's;* and in the 'Annals Nat. Hist.' for November, 1859, *Mr. Jacob*'s title to their authorship is shown.

We have, however, in our possession a copy of the work, which has evidently been the property of a naturalist, having the following note written on the fly-leaf, in ink apparently nearly as old as the book itself—"the scientific descriptions in this work were written by Dr. Solander."

The figures from the 'Testacea Minuta' were reprinted and further augmented in Kanmacher's edition of Adams's 'Essays on the Microscope' (1789), and the original work is therein stated to have been written by Mr. Walker and Mr. Boys, assisted by Edward Jacob, Esq., F.S.A.

We know that Dr. Solander wrote the scientific descriptions of Ellis's work on the 'Zoophytes,' and, singularly enough, Mr. Ellis's name appears in connection with some allied microscopical organisms on the following page in the 'Essays,' a fact which suggests associations increasing the probability of the manuscript note alluded to.

If Mr. Boys collected, Mr. Walker augmented and figured, Mr. Jacob assisted, Dr. Solander described, and Mr. Kanmacher further elaborated, added to, and republished, it is not easy to decide whose initials should be appended to such of their specific names as take precedence; at least, we see no reason to change the practice we have hitherto adopted in assigning them to "Walker and Jacob."

to a very variable amount of lateral compression, either on two, three, or four sides. Aperture usually single; in the exceptional distomatous forms the two orifices are at opposite ends of the shell. Shell-wall perforated by numerous very minute foramina.[1] Texture, hyaline.

For our views of the relationship of *Lagena*, in its manifold variations, see the 'Philos. Transact.,' 1865, vol. clv, p. 345, &c. The accompanying table of the distribution of fossil *Lagenæ* will be of interest to geologists, who can also refer to a general list of fossil and recent *Lagenæ*, by Prof. Reuss, in the 'Sitzungsb. Akad. Wiss. Wien.,' 1862, vol. xlvi, p. 317.

In our table we have arranged the *Lagenæ* according to our scheme of the prominent forms, as indicated in 'Phil. Trans.,' *loc. cit.*, p. 348, introducing some that do not occur fossil, to make the series complete; and we have introduced into the table materials from the works of Reuss, Seguenza, and others, having made their nomenclature conformable with ours.

[1] The keel of the compressed *Lagenæ*, and the marginal ribs of the angular varieties, are formed of "the supplementary skeleton," or secondary shell, containing what has been termed "the canal-system." Occasionally, as in *Lagena tubifero-squamosa*, P. & J. ('Phil. Trans.,' 1865, p. 420), the whole surface is coated with this extra shell-growth. The circular cavities, or "lacunæ," in the keel of *L. ornata*, shown in Williamson's 'Monograph,' pl. 1, fig. 24, are really continuous with the minute pseudopodial perforations of the shell-wall, usually by delicate bundles of tubuli; and they communicate with the exterior by a coarse pseudopodial tube.

TABLE SHOWING THE DISTRIBUTION OF THE CHIEF

vl. Very large. *l.* Large. *m.* Middle-sized. *s.* Small. VR. Very rare. R. Rare.

	Genus, Species, and Varieties.	Upper Chalk, Maestrich.	Eocene, Grignon.	Eocene ?, Septarienthon, Berlin. (Bornemann and Reuss.)	Eocene ?, Baljik, Bulgaria.	Miocene, Vienna. (D'Orb., Czjzek, and Reuss.)	Miocene, Lower Bavaria. (Egger.)
		1.	2.	3.	4.	5.	6.
1.	Lagena globosa, *Montagu*	*l* C	*vl* VC	*	...	...	*
2.	— lævis, *Montagu*	...	*l* VC	*	...	...	*
3.	— crenata, *Parker* and *Jones*	...	...	...	...	...	...
4.	— clavata, *D'Orbigny*	...	...	...	...	*	...
5.	— semistriata, *Williamson*	...	*m* R	*	*m* R	...	*
6.	— striata, *D'Orb.*	...	*m* RR	*	...	*	*
7.	— sulcata, *Walker* and *Jacob*	*vl* RC	*l* RC	*	...	...	*
8.	— striato-punctata, *P. & J.*	...	*s* VC	...	...	...	...
9.	— tetragona, *P. & J.*	...	*vs* C	...	...	...	...
10.	— acuticosta, *Reuss*	*	...	...	...	...	*
11.	— melo, *D'Orb.*	...	...	*	...	...	...
12.	— hexagona, *Williamson* (favosa, *Reuss*)	...	...	...	...	...	...
13.	— squamosa, *Montagu*	...	...	...	...	...	...
14.	— squamoso-tubifera, *P. & J.*	...	*vl* VC	...	...	...	...
15.	— hispida, *Reuss*	...	...	*	...	...	...
16.	— aspera, *Reuss*	*	...	...	...	...	...
17.	— marginata, *Montagu*	...	*l* VC	*	*m* R	*	*
18.	— ornata, *Williamson*	...	...	...	...	...	...
19.	— radiato-marginata, *P. & J.*	...	...	...	...	...	...
20.	— squamoso-marginata, *P. & J.*	...	*m* R	...	...	...	...
21.	— trigono-marginata, *P. & J.*	...	*s* VR	...	...	...	...
22.	— apiculata,[1] *Reuss*	*	...	*	...	...	...
23.	— gracillima, *Seguenza*[2]	...	...	...	..	...	...
24.	— caudata, *D'Orb.*	...	*s* C	...	..	...	...
25.	— distoma, *P. & J.*	...	...	...	..	...	...
26.	— distomo-aculeata, *P. & J.*	...	*s* VR	...	..	...	...
27.	— distomo-margaritifera, *P. & J.*	...	...	...	...	...	...
		1.	2.	3.	4.	5.	6.

[1] Found also in the Gault.—*Reuss.*

[2] We must also refer to Prof. Seguenza's 'Descrizione dei Foraminiferi Monotalamici,' &c., for some *prima*, and his *Trigonulinæ*, all from the Miocene marls of Messina. *Lagena trigono-marginata*, P. & J.,

FORMS OF LAGENA IN FOSSIL DEPOSITS.

RR. Rather rare. RC. Rather common. C. Common. VC. Very common.

Miocene, Bordeaux.	Miocene, Malaga.	Miocene, San Domingo.	Pliocene ?, Ototara, New Zealand.	Pliocene, Sienna.	Miocene, Sicily. (Seguenza.)	Pliocene, Antwerp Crag. (Reuss.)	Pliocene, Crag, Sutton.	Crag, Suffolk. (Mixed gatherings.)	Crag, Norwich.	Crag, Bridlington.	Pleistocene, Canada. (Dr. Dawson.)	Living.	
7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	
l VC	...	...	...	...	*	...	*s* R	*l* C	...	...	*	*	1.
l VC	...	...	...	...	*	*	*s* R	...	...	...	...	*	2.
m R	*m* RC	...	...	...	...	...	...	...	...	...	...	*	3.
m RR	...	...	...	...	*	*	...	...	...	...	...	*	4.
l VC	...	...	...	...	*	*	*s* VR	...	...	...	...	*	5.
l VC	...	...	...	*s* R	*	*	...	*m* VR	...	...	...	*	6.
m VC	...	...	*l* C	...	*	*	*vl* VC	*l* VC	*l* C	*m* R	*	*	7.
...	...	...	...	...	...	...	...	...	...	...	...	*	8.
...	...	...	...	...	...	...	...	...	...	...	...	...	9.
...	...	...	...	...	...	...	...	...	...	...	...	...	10.
...	...	...	...	...	*	...	...	*m* R	...	...	*	*	11.
...	...	...	...	...	...	...	...	...	...	...	...	*	12.
m R	...	...	*l* RR	...	*	*	...	*s* R	...	*s* R	*	*	13.
...	...	...	...	...	...	...	...	...	...	...	...	...	14.
...	...	...	...	...	*	...	...	...	...	...	...	...	15.
...	...	...	...	...	...	*	...	...	...	...	...	...	16.
m VC	*s* R	...	...	*s* R	*	...	*s* VR	*l* C	*m* VR	...	...	*	17.
...	...	...	...	...	*	...	*m* VR	...	...	...	...	*	18.
m RC	...	...	...	...	...	...	...	...	...	...	...	*	19.
...	...	*s* VR	...	...	...	...	...	...	...	...	...	*	20.
...	...	...	...	...	*	...	...	...	...	...	...	...	21.
...	...	...	...	...	*	...	*s* VR	...	...	...	...	*	22.
m R	...	...	...	...	*	...	*vl* R	...	...	...	...	*	23.
...	...	...	*m* C	...	*	...	*s* VR	...	...	...	*	*	24.
...	...	...	...	...	...	...	...	...	...	...	...	*	25.
...	...	...	...	...	...	...	...	...	...	...	...	...	26.
...	...	...	...	...	...	...	...	...	...	...	...	*	27.
7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	

other well-marked modifications of *Lagena;* such as his *Fissurina dentata, F. spinigera, Tetragonulina* is the same as *Trigonulina globosa,* Seg.

1. Lagena globosa, *Montagu*, Pl. I, fig. 32.

Serpula (Lagena) lævis globosa, *Walker* and *Jacob*, 1784. Test. Min., p. 3, pl. 1, fig. 8.
Vermiculum globosum, *Montagu*, 1803. Test. Brit., p. 523.
Serpula globosa, *Maton* and *Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 247.
— — *Turton*, 1819. Conch. Dict., p. 157.
— — *Fleming*, 1828. Brit. Anim., p. 235.
Oolina inornata, *D'Orb.*, 1839. Amer. Mérid., p. 21, pl. 5, fig. 13.
Entosolenia globosa, *Williamson*, 1848. Ann. Nat. Hist., 2nd ser., vol. i, p. 16, pl. 2, figs. 13, 14.
— lineata, *Id.* Ib., p. 18, pl. 2, fig. 18.
Oolina simplex, *Reuss*, 1851. Haiding. Naturw. Abhand., vol. iv, p. 22, pl. 1, fig. 2.
Cenchridium oliva, *Ehrenberg*, 1854. Mikrogeologie, part 2, p. 22, pl. 24, figs. 3, 4.
Miliola sphæroidea, *Id.* Ib., pl. 23, fig. 1.
— ovum, *Id.* Ib., pl. 23, fig. 2; pl. 27, fig. 1; pl. 29, fig. 45.
Fissurina obtusa, *Egger*, 1857. For. Mioc. Nied.-Bay., p. 8, pl. 1, figs. 16—19.
Entosolenia globosa, *Parker* and *Jones*, 1857. Ib., vol. xix, pl. 11, figs. 25—29.
— — (typica), *Will.*, 1858. Rec. For. Br., p. 8, pl. 1, figs. 15, 16.
Lagena (Entosolenia) globosa, *P.* and *J.*, 1859. Ann. N. Hist., 3rd ser., vol. iv, p. 341, &c.
Fissurina solida, *Seguenza*, 1862. Foram. Monotal. Mioc. Messin., p. 56, pl. 1, fig. 42.
— rugosula, *Id.* Ib., pl. 1, fig. 43.
Lagena globosa, *Reuss*, 1863. Sitz. Akad. Wiss. Wien., vol. xlvi, p. 318, pl. 1, figs. 1—3.
— inornata, *Id.* Ib., p. 32, pl. 1, fig. 12.
— globosa, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472.
— sulcata, var. (Entosolenia) globosa, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 348, pl. 13, fig 37; pl. 16, fig. 10.

Characters.—Shell ovato-globose, sometimes projecting slightly at the apex; smooth, and without surface-marking. Tube Entosolenian. Walls, thin and hyaline. Length $\frac{1}{100}$th inch or less to $\frac{1}{30}$th inch.

This is the simplest and, perhaps, the smallest of the Entosolenian *Lagenæ*, and holds an intermediate position between the smooth flask-shaped *E. lævis* and the swollen varieties of *L. marginata.* It was first figured and described by Walker and Boys, but not named by Walker and Jacob in Kanmacher's edition of Adams's 'Essays on the Microscope,' where the specific names given by Walker and Jacob are recorded. It was named by Montagu, 'Test. Brit.,' p. 523.

Lagena globosa is one of the commonest varieties of the genus. On all parts of the British coast it may be met with in dredged and littoral sands. At the Hunde Islands it has been found in material dredged at from thirty to seventy fathoms. In Baffin's Bay, lat. 75° 10′ N., long. 60° 12′ W., it seems to be rare, but is of large size—a curious

fact, corresponding to the occurrence of equally large individuals of this variety at very great depths (1080 fathoms) in the tropical Atlantic (lat. 2° 20′ N., long. 28° 44′ W.).

Professor Reuss has it fossil from the Chalk of Maestricht and of Lemberg, from the Oligocene Septarium-clay of Pietzpuhl, the Salt-clay of Wieliczka, and the Crag of Antwerp ('Monogr. Lagen.,' p. 318); and in other Tertiary deposits it is not uncommon.

The Crag specimens are generally above the average size; and the number of examples in the *Cardita senilis* bed and the bed with *Cyprina Islandica* is considerable.

2. Lagena lævis, *Montagu.* Plate I, fig. 28.

Serpula (Lagena) lævis ovalis, *Walker* and *Jacob*, 1784. Test. Minut., p. 3, pl. 1, fig. 9.
Vermiculum læve, *Montagu*, 1803. Test. Brit., p. 524.
Serpula lævis, *Maton* and *Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 247.
— — *Turton*, 1819. Conch. Dict., p. 157.
Lagenula — *Fleming*, 1828. Brit. Anim., p. 235.
— — *Macgillivray*, 1843. Moll. Anim. Aberd., p. 38.
— — *Thorpe*, 1844. Brit. Mar. Conch., p. 234.
Lagena — *Williamson*, 1848. Ann. Nat. Hist., 2nd ser., vol. i, p. 12, pl. 1, figs. 1, 2.
Cenchridium dactylum, *Ehrenb.*, 1854. Mikrogeologie, part 2, p. 22, pl. 24, figs. 1, 2.
Miliola lævis, *Id.* Ib., p. 23, pl. 32, fig. 2 *a* (not pl. 26, fig. 2).
Ovulina clava, *Id.* Ib., fig. 2 *b*.
Phialina oviformis, *Costa*, 1854—1856. Paleont. Napoli, pl. 11, fig. 9.
Amygdalina calabra, *Id.* Ib., p. 124, figs. 6, 8.
Lagena lævis, *Parker* and *Jones*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 279, pl. 11, figs. 22—24.
— vulgaris, *Will.*, 1858. Rec. For. Br., p. 4, pl. 1, figs. 5, 5 *a*.
Miliola styligera, *Ehrenb.*, 1858. Mikrogeologie, part 2, p. 23, pl. 31, fig. 6.
Lagena siphonifera, *Reuss*, 1858. Zeitschr. Deutsch. Geol. Ges., vol. x, p. 433.
— sulcata, var. lævis, *P.* and *J.*, 1859. Ann. N. Hist., 3rd ser., vol. iv, p. 341, &c.
— vulgaris *Reuss*, 1862. Sitz. Akad. Wiss., vol. xlvi, p. 321, pl. 1, fig. 15; pl. 2, figs. 16, 17.
Phialina propinqua, *Seguenza*, 1862. For. Mon. Mioc. Messin., p. 43, pl. 1, fig. 13.
— ovata, *Id.* Ib., p. 44, pl. 1, fig. 14.
— longirostris, *Id.* Ib., p. 44, pl. 1, fig. 15.
— affinis, *Id.* Ib., p. 44, pl. 1, fig. 16.
— clavata, *Id.* Ib., p. 45, pl. 1, fig. 17.
Lagena lævis, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472.
— sulcata, var. lævis, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 349, pl. 13, fig. 22; and pl. xvi, fig. 9 *a*.

Characters.—Shell flask-shaped, with elongated neck; smooth and destitute of ornament. Neck frequently thickened at the mouth, so as to form a sort of lip. Colour white; very transparent. Length $\frac{1}{80}$th to $\frac{1}{30}$th.

5

The distribution of the common, smooth, flask-shaped *Lagenæ* is world-wide; they are often found at considerable depths, but shallow water appears to be their favorite habitat. In the fossil state this smooth variety is very abundant in the Post-pliocene clays of Lincolnshire and Cambridgeshire, and in the Grignon beds (Eocene); it occurs also in the Vienna Tertiaries, and in the Crag of Antwerp and the Septarium-clay of Pietzpuhl (Reuss); in the Tertiary beds of Taranto (Costa), and in the Miocene clay of Messina (Seguenza).

The Crag specimens in Mr. Wood's Sutton collection are few in number, and small.

3. Lagena semistriata, *Williamson*. Plate IV, fig. 6.

Oolina striaticollis, *D'Orb.*, 1839. For. Amér. Mérid., p. 21, pl. 5, fig. 14.
Lagena striata, var. β, semistriata, *Williamson*, 1848. Ann. Mag. Nat. Hist., 2nd ser., vol. i, p. 14, pl. 1, figs. 9, 10.
Ovulina lacryma, O. tenuis, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 307, pl. 12, figs. 2, 3, 3*.
Oolina punctata, O. striatula, *Egger*, 1857. Foram. Mioc. Nied.-Bay., p. 6, pl. 1, figs. 1—8.
Lagena vulgaris, var. semistriata, *Williamson*, 1858. Rec. For. Br., p. 6, pl. 1, fig. 9.
— — var. perlucida, *Id.*, 1858. Ib., p. 5, pl. 1, figs. 7, 8.
— — var. semistriata, *Reuss*, 1862. Sitz. Akad., vol. xlvi, p. 322, pl. 2, figs. 18—21.
— tenuis (parte), *Id.* Ib., p. 325, pl. 3, figs. 34—39.
— striata (parte), *Id.* Ib., p. 327, pl. 3, fig. 45.
Phialina longissima, *Seguenza*, 1862. For. Mon. Mioc. Messin., p. 45, pl. 1, fig. 18.
— semicostata, *Id.* Ib., fig. 19.
Lagena sulcata, var. semistriata, *Parker* and *Jones*, 1862. In Append. Carpenter's Introd., p. 309.
— semistriata, *Brady*, 1864. Trans. Lin. Soc., vol. xxiv, p. 472.
— sulcata, var. semistriata, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 350, pl. 13, fig. 23.

Characters.—Shell flask-shaped, usually having the neck longer in proportion to the body than in the other varieties, having striæ and riblets extending from the base of the shell upwards for a short distance on the sides. Colour white; very transparent. Length $\frac{1}{80}$th to $\frac{1}{30}$th inch.

This is not an uncommon subvarietal form where *Lagenæ* prevail; but there is too little that is distinctive in its differentiation from elongated specimens of the typical *L. sulcata* to lay down any very definite scheme of its distribution. As Professor Williamson remarks, the costæ may terminate either in the lower, middle, or upper third of the shell; and though in the first or even the second case it would be easily recognised, it is obvious that in many individuals with longer ribs other characters, such as the length

of neck and general contour of the shell, would have to be chiefly considered; and these, as we well know, are extremely variable. D'Orbigny's figure of *L. striatocollis* represents a poorly defined specimen of this subtype.

It is very common to meet with *Lagenæ*, both recent and fossil, taking on striæ and riblets to greater or less extent, as in this instance. Reuss figures finely striated specimens from the Crag of Antwerp in his paper on the *Lagenidæ*, 'Sitzungsb. Wien. Akad.,' vol. xlvi, pl. 2, figs. 18—21. Dr. Wallich, in his memoir on the North-Atlantic sea-bed, figures *L. semistriata* (pl. 5, fig. 17); and D'Orbigny's *Oolina striaticollis* (Falkland Isles) belongs to the same variety. It is a common form on our British coast. Egger's *Oolina striatula* offers an interesting passage-form (especially his fig. 6) between *L. semistriata* and *L. crenata*, P. and J.

Only a single broken specimen has occurred to us in our examination of the Crag deposits, and this is from Sutton.

4. Lagena striata, *D'Orbigny* (not of *Montagu* and *Williamson*). Plate I, figs. 38—40.

Oolina striata, *D'Orb.*, 1839. Foram. Amér. Mérid., p. 21, pl. 5, fig. 12.
— Haidingeri, *Czjzek*, 1847. Haiding. Nat. Abhandl., vol. ii, p. 138, pl. 12, figs. 1, 2.
Lagena substriata, *Williamson*, 1848. Ann. N. H., 2nd ser., vol. i, p. 15, pl. 2, fig. 12.
Ovulina sicula, *Ehrenb.*, 1854. Mikrogeologie, part 2, p. 23, pl. 26, fig. 1.
Lagena vulgaris, var. gracilis, *Will.*, 1858. Rec. For. Brit., p. 7, pl. 1, figs. 12, 13.
— — var. substriata, *Id.* Ib., p. 7, pl. 1, fig. 14.
— gracilicosta, *Reuss*, 1858. Zeitsch. Deut. Geol. Ges., vol. x, p. 434; 1862, Sitz. Akad. Wien., vol. xlvi, p. 327, pl. 3, figs. 42, 43.
— striata (parte), *Id.*, 1862. Sitz. Akad., vol. xlvi, p. 327, pl. 3, fig. 44; pl. 4, figs. 46, 47.
Ovulina striata, *Seguenza*, 1862. Foram. Monot. Messina, p. 40, pl. 1, figs. 6, 7.
Phialina Haidingeri, *Id.* Ib., p. 46, pl. 1, fig. 20.
— tenuistriata, Ph. Gemellarii, Ph. cylindracea, *Id.* Ib., figs. 21, 23, 24.
Lagena — *Stache*, 1865. Novara-Exped., Geol. Theil., vol. i, part 2, p. 184, pl. 22, fig. 4 (like our fig. 40, Pl. I).

Characters.—Flask-shaped *Lagenæ* of variable dimensions, ornamented with delicate longitudinal and sometimes spiral striæ and riblets, come under the denomination of *L. striata*. (See the scheme of *Lagenæ*, 'Phil. Trans.,' 1865, vol. clv, p. 384.) Out of this, however, as also out of the other groups, we separate the caudate or apiculate forms, leading towards the double-mouthed or distomatous, perforate, cylindrical *Lagenæ*, with which they make another artificial division.

L. striata accompanies the more common and strongly grown *Lagenæ* all over the world, and have existed with them in Tertiary times. We have a few specimens from the Crag of Sutton and of Sudbourne.

5. Lagena sulcata, *Walker* and *Jacob*. Plate I, figs. 41—43.

Serpula (Lagena) striata sulcata rotundata, *Walker* and *Jacob*, 1784. Test. Min., p. 2, pl. 1, fig. 6.
Serpula (Lagena) sulcata, *Id.*, 1798. In Adams's Essays Microsc. (Kanmacher), p. 634, pl. 14, fig. 5.
Serpula lagena, *Turton*, 1802. Syst. Nat., vol. iv, p. 609.
Vermiculum striatum, *Montagu*, 1803. Test. Brit., part ii, p. 523.
— perlucidum, *Id.* Ib., p. 525, pl. 14, fig. 3.
Lagenula striata, L. perlucida, *Fleming*, 1828. Brit. Anim., pp. 234, 235.
Oolina Villardeboana, *D'Orb.*, 1839. For. Amér. Mérid., p. 5, pl. 5, figs. 4, 5.
— Isabella, *Id.* Ib., p. 20, pl. 5, figs. 7, 8.
— raricosta, *Id.* Ib., p. 20, pl. 5, figs. 10, 11.
Lagena striata, *Williamson*, 1848. Ann. N. Hist., 2nd ser., vol. i, p. 13, pl. 1, figs. 6 and 8.
— — var. α, interrupta, *Id.* Ib., fig. 7.
— — var. γ, perlucida, *Id.* Ib., fig. 11.
Miliola striata, *Ehrenb.*, 1854. Mikrogeol., part 2, p. 22, pl. 24, fig. 5; pl. 32, fig. 1.
Ovulina elegantissima, *Bornemann*, 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 315, pl. 12, fig. 1.
Entosolenia globosa, var. striata, *Parker* and *Jones*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 278, pl. 11, fig. 27.
Lagena vulgaris, var. perlucida, *Williamson*, 1858. Rec. For. Brit., p. 5, pl. 1, fig. 8.
— — var. striata, *Id.* Ib., p. 6, pl. 1, fig. 10.
— — var. interrupta, *Id.* Ib., p. 7, pl. 1, fig. 11.
Entosolenia costata, *Id.* Ib., p. 9, pl. 1, fig. 18.
Lagena sulcata, *Parker* and *Jones*, 1859. Ann. N. H., 3rd ser., vol. iv, p. 341, &c.
Ovulina sulcata, *Seguenza*, 1862. Foram. Mon. Mioc. Messina, p. 41, pl. 1, figs. 8—10.
Phialina lagena, *Id.* Ib., p. 46, pl. 1, fig. 22.
— exigua, P. incerta, P. costata, P. Costæ, P. Reussiana, *Id.* Ib., p. 47, 48, pl. 1, figs. 25—29.
Obliquina acuticosta, *Id.* Ib., p. 75, pl. 2, figs. 65—67.
Lagena filicosta, *Reuss*, 1863. Sitz. Akad. Wien., vol. xlvi, p. 328, figs. 50, 51.
— Villardeboana, L. costata, L. Isabella, L. amphora, *Id.* Ib., p. 329, 330, pl. 4, figs. 53—57.
— sulcata, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472.
— — *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 351, pl. 13, figs. 24, 28—32; and pl. 16, figs. 6, 7, 7 *a*.

Characters.—Shell subspherical, oval, or flask-shaped, having a surface-ornamentation of parallel costæ, more or less strongly marked, generally extending from one end of the shell to the other. Colour white to brownish. Length, $\frac{1}{30}$th to $\frac{1}{70}$th inch.

We regard this as the typical form of *Lagena*, for its variations lead, in one direction, into feebler forms, such as *L. semistriata*, *lævis*, and *globosa;* and on the other hand we have varieties with reticulated, hispid, and granular ornament; we have also compressed forms and elongate varieties, departing more or less widely from the middle type presented by the ovate and characteristically costate *Lagenæ*.

The chief variations from this central type depend upon alterations in the nature of surface-ornamentation, or the shape, length, and direction of the neck. We are fully convinced that there is no true specific division determinable from these characters, either among the costate group above indicated, or even in the much wider range of *Lagenæ* in general. The division of the genus into Ectosolenian (*Lagena*) and Entosolenian (*Entosolnia*) groups, adopted by Professor Williamson, in his Memoir on the *Lagenæ*, and in his Monograph, whilst it might afford us some general assistance in classifying a bulky list of varieties, seems only to lead into greater difficulties, for we find that the principal forms may be traced in series from the pear-shaped body, with the long, thick-lipped neck, through every gradation of shortening, and eventually of intussusception. But if the distinctions founded on contour be thus open to objection, still less dependence is to be placed on the shape of the aperture, for systematic purposes. There can be little doubt that the typical form of the aperture, if we may judge from the finest and most fully developed specimens, is very similar to that of the *Polymorphinæ* and *Nodosarinæ*, a circular orifice surrounded by radiating lines. The radiation is only to be observed in exceptional specimens; but the majority of the *Lagenæ* preserve the circular form of orifice. In the feebler varieties, especially those which have no neck, there is a tendency towards an oval form of orifice, and in the flattened specimens grouped as *L. marginata* the typical round mouth is represented by a mere slit. Professor Reuss has divided his family *Lagenida* into two genera, *Lagena* and *Fissurina*, on these peculiarities. It has been reserved for Professor Seguenza to carry subdivision to an extreme. He recognises no less than eight "genera" of *Lagenida*, namely, *Ovulina* (shell oval, aperture circular), *Phialina* (shell oval, aperture at the top of an elongated tube), *Amphorina* (shell fusiform, aperture circular), *Tetragonulina* (shell square and tubulated, aperture circular), *Fissurina* (shell compressed and equilateral, aperture in the form of a slit), *Amygdalina* (shell compressed and inequilateral, aperture slit-like), *Trigonulina* (shell triangular, aperture slit-like), and, lastly, *Obliquina* (shell twisted, aperture circular).

We need not say that with such a generic subdivision we have no agreement; and still less, if it were possible, with his list of new species—an example of hair-splitting to which we know of no parallel in systematic zoology. Of the 102 "new species" of *Lagenæ* described in his memoir, there may, perhaps, be four or five undescribed forms worthy of subvarietal names; the rest are ordinary specimens of well-known forms, long since described. If the system pursued by the Italian professor were to be followed, it would soon become necessary to describe and name every individual specimen.

As we have before stated, the situation of the general aperture in relation to the body of the shell is exceedingly open to variation, even in groups of specimens identical in their other characters. We find in rare examples, under similar limitations, another complicity in the classification, arising from the occurrence of an orifice at each end of the shell. This peculiar development may be traced through the "caudate" varieties of the various forms; and, as all the feeble *Lagenæ*, especially clear-shelled and slightly striated individuals, have

their mucronate or caudate representatives, so many of them are produced still further, and have shells of fusiform contour, with both ends open for the passage of the larger pseudopodia. Specimens of this sort have been repeatedly figured, but their structural peculiarity appears entirely to have escaped the notice of Continental rhizopodists. Seguenza's genus *Amphorina* seems, judging by his figures, to consist of subvarieties of *Lagena sulcata caudata* and *L. sulcata distoma;* and an analysis of them will be found at p. 45, with the remarks on a distomatous form we have from the Sutton Crag.

The typical *Lagena sulcata* has a world-wide distribution, accommodating itself to almost all climates and depths. The finest specimens are found at a depth of from 50 to 100 fathoms, but it is plentiful in the shallowest water, and has been found in soundings as deep as 2350 fathoms in the Atlantic.

Its distribution in time appears to have commenced with the Upper Chalk of Maestricht. It is found in many of the European Tertiaries.

In the Crag, *L. sulcata* is a common fossil. The specimens from Sutton are fine and well marked; those from the Cyprina-bed are large, but in the bed with *Cardita* and in the Upper Crag at Thorpe the examples are smaller.

6. Lagena Melo, *D'Orbigny*. Plate I, fig. 35.

Oolina Melo, *D'Orb.*, 1847. Foram. Amér. Mérid., p. 20, pl. 5, fig. 9.
Entosolenia squamosa, var. α, catenulata, *Williamson*, 1848, Ann. Nat. Hist., 2nd ser., vol. i, p. 19. pl. 2, fig. 20; 1858, Rec. For. Br., p. 13, pl. 1, fig. 31.
— — var. β, scalariformis, *Id.* A. N. H., 2nd ser., vol. i, p. 19, pl. 2, figs. 21, 22.
— globosa, var. catenulata, *Parker* and *Jones*, 1857. Ib., 2nd ser., vol. xix, p. 278, pl. 11, fig. 26.
Ovulina reticulata, *Seguenza*, 1862. Foram. Monotal. Miocen. Messin., p. 42, pl. 1, fig. 11.
Lagena Melo, *P.* and *J.*, 1862. Append. Carpenter's Introd., p. 309.
— foveolata, *Reuss*, 1862. Sitz. Akad. Wien., vol. xlvi, p. 332, pl. 5, fig. 65.
— scalariformis (parte), *Id.* Ib., pl. 5, fig. 71.
— catenulata, *Id.* Ib., pl. 6, figs. 75, 76.
— Melo, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472; 1865, Nat. Hist. Trans., North. and Durham, vol. i, p. 97.
— sulcata, var. (Entosolenia) Melo, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 354, pl. 13, figs. 33—36.

Characters.—Shell ovato-globose or pear-shaped, usually Entosolenian. Surface covered by reticulated ornament of longitudinal and transverse ridges, the transverse being frequently less freely developed than the longitudinal bars. Colour white or dirty white. Length $\frac{1}{100}$th or less to $\frac{1}{50}$th inch.

Lagena Melo may be looked upon as intermediate between *L. sulcata* and *L. squa-*

mosa. Many specimens show their connection with the former in having stout longitudinal ridges, with very slightly developed cross-bars; whilst others, with equally grown ornament, only want a zigzag inflection of the primary costæ to give them the characters of *L. squamosa.* We have suggested an artificial division of these closely allied *Lagenæ* into—1, those with square meshes (*L. Melo*); 2, those with six-sided meshes (*L. hexagona*, Will. *L. favosa*, Reuss); and 3, those with both four- and six-sided meshes (*L. squamosa*, Mont.). The last two groups may be conveniently treated of together, as below. *Lagena Melo* is not uncommon in company with other members of the group, though not so frequent as the smooth, sulcate, honeycombed, and marginate varieties; and it has the same world-wide distribution; it is found fossil also in many Tertiary beds. For its occurrence (recent and fossil) in the Mediterranean area, see 'Quart. Journ. Geol. Soc.,' vol. xvi, Table, p. 302.

In the Crag it appears confined to the bed at Gedgrave, containing *Cardita senilis*; and the specimens are rare.

7. Lagena squamosa, *Montagu.* Plate IV, fig. 7.

Vermiculum squamosum, *Montagu*, 1803. Test. Brit., p. 526, pl. 14, fig. 2.
Serpula squamosa, *Maton* and *Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 247.
— — *Turton*, 1819. Conch. Dict., p. 158.
Lagenula — *Fleming*, 1828. Brit. Animals, p. 235.
— reticulata, *Macgillivray*, 1843. Moll. Anim. Aberdeen, p. 28.
— squamosa, L. reticulata, *Thorpe*, 1844. Brit. Mar. Conch., pp. 234, 235.
Entosolenia — *Williamson*, 1848. Ann. Nat. Hist., 2nd ser., vol. i, pl. 2, fig. 19.
— — var., γ hexagona, *Id.* Ib., fig. 23.
— globosa, var. squamosa, *Parker* and *Jones*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 278, pl. 11, fig. 25.
— squamosa (typica), *Will.*, 1858. Rec. For. Br., p. 12, pl. 1, fig. 29.
— — var. scalariformis, *Id.* Ib., p. 13, pl. 1, fig. 30.
— — var. hexagona, *Id.* Ib., fig. 32.
Lagena reticulata, *Reuss*, 1862. Sitz. Akad. Wien., vol. xlvi, p. 333, pl. 5, figs. 67, 68.
— scalariformis (parte), *Id.* Ib., figs. 69, 70.
— favosa, *Id.* Ib., p. 334, pl. 5, figs. 72, 73.
— geometrica, *Id.* Ib., fig. 74.
Ovulina ornata, *Seguenza*, 1862. Foram. Monotal. Miocen. Messin., pl. 42, p. 1, fig. 12.
Phialina — *Id.* Ib., p. 48, pl. 1, fig. 30.
Lagena squamosa, *P.* and *J.*, 1862. Append. Carpenter's Introd., p. 309.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 472; 1865, Nat. Hist. Trans. Northumb. and Durham, vol. i, p. 97.
— sulcata, var. squamosa, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 354, pl. 13, figs. 40, 41; pl. 16, fig. 11.
— anomala, *Stache*, 1865. Novara-Exped., Geol. Theil., vol. i, part 2, p. 183, pl. 22, fig. 5.

Characters.—Shell ovato-globose or pear-shaped, usually Entosolenian. Surface covered with an ornamentation of elevated ridges, forming a network with hexagonal or sub-hexagonal meshes. Colour white to yellowish. Length $\frac{1}{100}$th or less to $\frac{1}{50}$th inch.

This represents a state of ornamentation peculiar to the *Lagenæ* amongst the "hyaline," and to certain varieties of *Miliola seminulum* among the "porcellanous" Foraminifera. In *L. Melo* the cross-bars are often weaker than the longitudinal ribs, and pass straight across from rib to rib, like the secondary veins in a monocotyledonous leaf, such as *Alisma, Myrsiphyllum,* &c. In *L. squamosa,* however, not only have the secondary riblets become equal to the primary, but, by the zigzag inflection of the latter, a nearly regular hexagonally areolated ornament is produced, reminding one strongly of the polygonal meshes produced by the more perfect reticulation of the woody skeleton of a dicotyledonous leaf. Early observers, using but imperfect microscopes, compared this retose ornament with a scaly skin of a fish (see Williamson, 'Monograph,' p. 12), and, indeed, from young and small specimens, mounted in Canada balsam and viewed as transparent objects, it would be almost impossible, even with the best instruments, to contradict such a diagnosis.

Professor Reuss, in his 'Memoir on the *Lagenidæ,*' pl. 5, fig. 74, figures, under the name of *L. geometrica,* a very beautiful modification of this variety, in which the ornament takes the form of very small, regular, hexagonal meshes, separated by delicately thin elevated walls. Professor Williamson's figure ('Monogr.,' pl. 1, fig. 32) of *L. squamosa,* var. *hexagona,* represents a similarly regular marking, but here the ridges are broader, and the number of meshes finer. His *L. squamosa,* var. *scalariformis,* has the same general character, but there is proportionately a smaller amount of ornament, and the interstitial spaces are still larger.

In this reticulate *Lagena* the neck is usually intussuscepted (Entosolenian); but in one of the large fossil form (*L. squamoso-tubifera,* Parker and Jones, 'Phil. Trans.,' 1865, pl. 18, fig. 7), the neck is protruded in some cases to a considerable extent, and has about three secondary tubular apertures arising from it laterally, and almost at right angles to the main tube. This is an isomorphism with *Polymorphina tubulosa,* and with certain feeble bifurcating forms of *Nodosaria* from Cretaceous beds.

L. squamosa is of world-wide occurrence; but, like *L. Melo,* is not so abundant as the long flask-shaped and the marginated forms. In the Arctic Seas it is not uncommon, and on our own shores it is found sparingly everywhere. It is found fossil in the Black Crag of Antwerp (Reuss), and in the Tertiary clays of North Italy. By far the bulkiest specimens of *L. squamosa* that we have seen are from a Tertiary sand, which, rich in many varieties of *Lagenæ,* in *Ovulites, Polymorphina,* and *Vertebralina,* was taken from the inside of a *Cerithium giganteum* from Grignon. A single specimen collected by Mr. H. C. Sorby, at Bridlington, kindly placed in our hands with his other specimens from the same locality, is the only instance we know of its occurrence in the Pliocene beds of Britain.

8. LAGENA MARGINATA, *Walker* and *Jacob*. Plate I, figs. 33, 34.

Serpula (Lagena) marginata, *Walker* and *Jacob*, 1784. Test. Min., p. 3, pl. 1, fig. 7.
VERMICULUM MARGINATUM, *Montagu*, 1803. Test. Brit., p. 524.
SERPULA MARGINATA, *Maton* and *Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 247.
OOLINA COMPRESSA, *D'Orb.*, 1839. Foram. Amér. Mérid., p. 18, pl. 5, figs. 1, 2.
LAGENULA MARGINATA, *Thorpe*, 1844. Brit. Mar. Conch., p. 234.
OOLINA COMPRESSA, *D'Orb.*, 1846. For. Fos. Vien., p. 24, pl. 21, figs. 1, 2.
ENTOSOLENIA MARGINATA, *Williamson*, 1848. Ann. Nat. Hist., 2nd ser., vol. i, p. 17, figs. 15—17.
FISSURINA LÆVIGATA, *Reuss*, 1849. Denks. Akad. Wien., vol. i, p. 366, pl. 46, fig. 1.
— ALATA, *Id.*, 1851. Zeits. Deut. Geol. Ges., vol. iii, p. 58, pl. 3, fig. 1.
— GLOBOSA, *Bornemann*, 1856. Zeits. Deut. Geol. Ges., vol. vii, p. 315, pl. 12, fig. 4.
ENTOSOLENIA — var. MARGINATA, *P.* and *J.*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 278, pl. 11, figs. 28, 29.
— MARGINATA, *Will.*, 1858. Rec. For. Br., p. 10, pl. 1, figs. 19—21.
— — varr. LUCIDA, QUADRATA, *Id.* Ib., pp. 10, 11, pl. 1, figs. 22, 23, 27, 28.
FISSURINA OBLONGA, *Reuss*, 1858. Sitz. Akad. Wien., 1862, vol. xlvi, p. 339, pl. 7, fig. 89.
— CARINATA, *Id.*, 1862. Ib., vol. xlvi, p. 338, pl. 6, fig. 83; pl. 7, fig. 86.
LAGENA MARGINATA, *P.* and *J.*, 1862. Append. Carpenter's Introd., p. 309.
FISSURINA SIMPLEX, *Seguenza*, 1862. Foram. Monotal. Miocen. Messin., p. 56, pl. 1, fig. 44.
— DELTOIDEA, *Id.* Ib., p. 57, pl. 1, fig. 45.
— LATISTOMA, *Id.* Ib., figs. 46, 47.
— BIANCÆ, *Id.* Ib., figs, 48—50.
— ACUTA, *Id.* Ib., fig. 51.
— PECCHIOLII, *Id.* Ib., p. 58, pl. 1, fig. 52.
— COMMUNIS, *Id.* Ib., p. 59, pl. 1, figs. 56, 57.
— PROPINQUA, *Id.* Ib., fig. 58.
— ARADASII, *Id.* Ib., fig. 59.
— APERTA, *Id.* Ib., p. 60, pl. 1, fig. 60.
— OBVIA, *Id.* Ib., pl. 2, fig. 1.
— TENUIS, *Id.* Ib., fig. 2.
— ELLIPTICA, *Id.* Ib., fig. 3.
— OVATA, *Id.* Ib., p. 62, pl. 2, figs. 9, 10.
— BENOITIANA, *Id.* Ib., fig. 11.
— HAECKELII, *Id.* Ib., p. 63, pl. 2, fig. 13.
— INÆQUALIS, *Id.* Ib., fig. 14.
— CIRCULUM, *Id.* Ib., fig. 15.
— SILVESTRII, *Id.* Ib., p. 64, pl. 2, fig. 18.
— EMARGINATA, *Id.* Ib., p. 65, pl. 2, fig. 20.

Fissurina dilatata, *Seguenza*, 1862.		For. Monot. Mioc. Messin., p. 65, pl. 2, fig. 21.
— lævis,	*Id.*	Ib., p. 66, pl. 2, figs. 22, 23.
— Romettensis,	*Id.*	Ib., fig. 24.
— Orbignyana,	*Id.*	Ib., figs. 25, 26.
— marginata,	*Id.*	Ib., figs. 27, 28.
— sulcata,	*Id.*	Ib., p. 67, pl. 2, fig. 29.
— tubulosa,	*Id.*	Ib., p. 68, pl. 2, figs. 36, 37.
— Costæ,	*Id.*	Ib., p. 69, pl. 2, fig. 38.
— elegans,	*Id.*	Ib., fig. 39.
— Gemellarii,	*Id.*	Ib., p. 70, pl. 2, fig. 45.
— regolaris,	*Id.*	Ib., p. 71, pl. 2, fig. 46.
— Sartorii,	*Id.*	Ib., fig. 47.
— Lyellii,	*Id.*	Ib., figs. 48, 49.
— Rizzae,	*Id.*	Ib., fig. 50.
Amygdalina truncata,	*Id.*	Ib. p. 73, pl. 2, figs. 52, 53.
Lagena marginata, *Brady*, 1864.		Trans. Linn. Soc., vol. xxiv. p. 472.
— sulcata, var. (Entosolenia) marginata, *P.* and *J.*, 1865.		Phil. Trans., vol. clv, p. 355, pl. 13, figs. 42—44; pl. 16, fig. 12.

Characters.—Shell orbicular, compressed, with a more or less prominent marginal ridge or carina. Tube either Ectosolenian or Entosolenian. Aperture oval or slit-like. Surface smooth. Colour white or dirty white. Length $\frac{1}{100}$th or less to $\frac{1}{30}$th inch.

Under the general name *Lagena marginata* are included a large number of flattened forms, variable in shape, generally Entosolenian, but sometimes Ectosolenian with a long delicate neck. This compressed shape is usually associated with a trenchant margin, sometimes slightly apiculated, and sometimes dentate or rowelled (as in Williamson's 'Monograph,' pl. 1, figs. 21 *a*, 25, 26), reminding us of the keel of certain *Cristellariæ*. Occasionally, in large well-developed specimens of *L. marginata* (recent and fossil) the margin is composed of a large predominant rib, strengthened by a pair of smaller costæ (*L. fasciata*, Egger, &c.), showing that, as in other Foraminifera, especially the Nodosarine group, the exogenous costæ gather themselves to the margins, the rest of the surface becoming less and less ornamented. The pseudopodial pores also usually affect the neighbourhood of the thickened margin in these flattened forms, just as they follow the ridges of *L. striato-punctata*. Occasionally the pseudopodia have perforated the whole surface, either sparsely, or freely, as we have seen in specimens from the Indian Sea. In some rare specimens from the Coral-reefs of Australia, and fossil at Bordeaux, we see the pseudopodia begin to enter the shell-wall near the centre, and then burrow radially to escape near the margin, the shell-surface being perfectly smooth and as polished as glass (*L. radiato-marginata*, P. & J.).

The intussuscepted neck-tube in *L. marginata* is generally more or less oblique, somewhat trumpet-shaped, and of varying length. The apparent difference in the setting on of the mouth, which we formerly thought we could detect, between *Entosolenia* and *Lagena* proper ('Annals Nat. Hist.,' 2nd ser., vol. xix, p. 279) does not really

exist; for we find that in any of the subspecific groups forms may occur having either a gently tapering neck (Ectosolenian), or a tube abruptly set in (Ento-ecto-solenian), or a mouth-tube entirely intussuscepted (Entosolenian). *L. marginata* is sometimes distomatous, being open at the base, and then coming under another (artificial) subdivision.

No division of the species can be made depending on the general form of the shell; from nearly globose to the most compressed and carinate specimen every gradation of contour may be shown.

The distribution of *Lagena marginata* is world-wide. Professor Williamson has recorded its occurrence at 100 fathoms at the Hunde Islands ('Monogr.,' pp. 10, 11); and we have found it in Dr. Sutherland's dredgings from the same locality (30 to 70 fathoms), as well as in Messrs. MacAndrew and Barrett's material brought from Drontheim, North Cape (30 to 200 fathoms). On our own shores it is common everywhere. For some of its Mediterranean habitats (recent and fossil) see 'Quart. Journ. Geol. Soc.,' vol. xvi, p. 302, Table. Under the name of *Oolina compressa,* D'Orbigny described it as occurring with other *Lagenæ* at the Falkland Isles. It is figured by J. D. Macdonald, Assist. Surgeon H. M. S. Herald, in the 'Annals Nat. Hist.,' 2nd ser., vol. xx, pl. 5, figs. 7—10, but not described. He found it, together with *Uvigerina dimorpha, Spiroloculina planata, Quinqueloculina seminulum,* and *Triloculina oblonga,* in 400 fathoms water, between Ngaa and Viti-Laru, in the Fiji group of islands. We have seen specimens hexagonally areolated, like *L. squamosa,* but less distinctly so, from the Tertiary beds of San Domingo, and from the white mud of the Australian Coral-reefs (*L. squamoso-marginata,* P. and J.).

Large specimens of *L. marginata* are not uncommon in the Crag with *Cyprina Islandica;* and, less finely grown, it is frequent in the Gedgrave bed with *Cardita senilis.*

9. Lagena ornata, *Williamson.* Plate I, figs. 29—31.

Entosolenia marginata, var. ornata, *Williamson,* 1858. Rec. For. Brit., p. 11, pl. 1, fig. 24.
— — var. lagenoides, *Id.* Ib., figs. 25, 26.
Lagena lagenoides, *Reuss,* 1862. Sitz. Akad. Wien., xlvi, p. 324, pl. 2, figs. 27, 28.
Fissurina trapezoidea, *Seguenza,* 1862. Foram. Monot. Mioc. Mess., p. 68, pl. 2, fig. 34.
— Reussiana, *Id.* Ib., p. 69, pl. 2, fig. 40.
— radiata, *Id.* Ib., p. 70, pl. 2, figs. 42, 43.

Characters.—Flask-shaped, with or without neck; either Ento- or Ecto-solenian, or both, more or less compressed, and having its margin produced to a variable extent, and

traversed by pseudopodial tubes, with a somewhat radial arrangement, often giving the margin the appearance sometimes of being more or less regular plicated.

Length $\frac{1}{45}$th inch.

In fact, we have in this case one of the subvarieties of *Lagena marginata* mentioned in 'Phil. Trans.,' 1865, p. 335, and alluded to above in our account of the last-named form. Among the several modifications of the type, this presents one with the radiating canals visible only at the margin. Prof. Williamson's *Entosolenia marginata*, var. *ornata*, especially possesses the subtypical character above mentioned; and his *E. marginata*, var. *lagenoides*, as represented by the fig. 26 in his 'Monograph' (badly copied in Prof. Reuss's 'Monograph of the *Lagenida*,' 1862, pl. 2, fig. 27, and misnamed "*appendiculata*" in the plate), has this character plain enough, though not so symmetrically perfect as in our specimen from the Crag. Prof. Seguenza has recorded some beautiful specimens; his *Fissurina trapezoides* is almost identically the same as Williamson's fig. 26; but his *F. radiata* and *F. Reussiana* are beautiful developments of the same form; indeed, we regret that the exigencies of zoological nomenclature debar us from keeping our highly esteemed German friend's name permanently associated with so elegant a *Lagena*.

L. ornata, with its neatly radiate margin, does not seem to be a very rare form among other *Lagenæ* (Davis' Straits and British coast, recent; Sicily, fossil); besides two or three small specimens, we have from the Crag of Sutton one at least as beautiful as Seguenza's *L. Reussiana*.

10. Lagena apiculata, *Reuss*. Plate I, fig. 27.

Oolina apiculata, *Reuss*, 1850. Haiding. Nat. Abhandl., vol. iv, p. 22, pl. 1, fig. 1.
Lagena — *Id.*, 1862. Sitz. Akad. Wien., vol. xlvi, p. 319, pl. 1, figs. 4—8, 10, 11.
Fissurina acuta, *Id.* Ib., p. 340, pl. 7, figs. 40, 41.
Ovulina caudigera, *Seguenza*, 1862. Foram. Mon. Mioc. Mess., p. 39, pl. 1, fig. 3.
— perforata, *Id.* Ib., p. 40, pl. 1, fig. 4.
Amphorina globosa, *Id.* Ib., p. 50, pl. 1, fig. 31.
— tenuicalcar, *Id.* Ib., fig. 32.
— elongata, *Id.* Ib., fig. 34.
Lagena sulcata, var. (Entosolenia) apiculata et caudata, *P.* and *J.*, 1865. Phil. Trans., vol. clv, p. 358.

Characters.—Shell oval, subspherical, or flask-shaped; smooth, with the base either merely apiculate, or drawn out into a tubular prolongation.

Length $\frac{1}{100}$th inch and upwards.

Similar forms are often ornamented with striæ and costulæ, such as *L. caudata*, D'Orb.; and the two groups together, as we have already noticed (p. 35), when referring to our scheme of the division of the *Lagenæ*, may be referred to under that name, as an intermediate

set of forms, leading from the common round-based varieties towards the distomatous series.

These smooth apiculate *Lagenæ*, or smooth subvarieties of *L. caudata*, D'Orb., are found in many places in company with the common *Lagenæ*, and they are fossil in the Tertiary strata. One or two small specimens only have occurred to us in the Crag of Sutton.

11. LAGENA GRACILLIMA, *Seguenza*. Plate I, figs. 36, 37.

MILIOLA LÆVIS, *Ehrenberg* (parte), 1845. Mikrogeol., part 2, p. 22, pl. 26, fig. 2.
LAGENA LÆVIS, *Parker* and *Jones*, 1857. Ann. N. Hist., 2nd ser., vol. xix, p. 278, pl. 11, fig. 23.
AMPHORINA ACUMINATA, *Seguenza*, 1862. Foram. Monotal. Mioc. Messin., p. 51, pl. 1, fig. 35.
— CYLINDRACEA, *Id.* Ib., fig. 36.
— GRACILLIMA, *Id.* Ib., fig. 37.
— DISTORTA, *Id.* Ib., p. 52, pl. 1, fig. 38.
LAGENA SULCATA, var. DISTOMA-POLITA, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 357, pl. 13, fig. 21; pl. 18, fig. 8.

Characters.—Shell much elongated, fusiform, distomatous, often twisted or curved. Both extremities subulate. Surface smooth. The hyaline texture of the young shell becomes opaque white in older specimens.

Length $\frac{1}{36}$th to $\frac{1}{8}$th inch

This may be regarded as the distomatous form, corresponding to *L. lævis* in the single-mouthed series. Although it has been found elsewhere, both in recent and fossil condition, we have never seen specimens approaching those from the Crag in point of size, except from the Red Sea and Australia; indeed, those in Mr. Wood's collection from Sutton are the largest *Lagenæ* with which we are acquainted.

Fig. 37, Plate I, represents a portion of the shell more highly magnified, and shows very beautifully its foraminated structure. It may be constantly noticed, in examining the shells of *Lagenæ* under high powers, that the amount of perforation varies with the thickness of the wall; that in the thinner, more delicate portions the foramina are few and indistinct, whilst in those places in which it assumes stouter proportions the surface is closely studded with dots indicating the open ends of the tubuli.

Distomatous *Lagenæ* are by no means common. The best-known form has an elongated, straight-sided shell, with delicate, parallel, longitudinal striæ (*Lagena distoma*, P. and J.), occasionally found in deepest soundings in the Northern Seas.

Seguenza, in his 'Monografia dei Foraminiferi Monotalamici delle Marne Mioceniche Messinesi,' figures four smooth-shelled double-mouthed specimens with as many different specific names. Three of these are symmetrical, and one of them (fig. 37) the exact counter-

part of *L. distoma-polita*, P. and J., from Australia; the fourth (*Amphorina distorta*) is unsymmetrical, and altogether analogous to those found in the Crag.

We choose the term "*gracillima*," as having been applied to the most typical form. Seguenza's *Amphorina globosa*, *Am. tenuicalcar*, *Am. olivæformis*, and *Am. elongata* (figs. 31—34), are *apiculate* individuals standing between *Lagena gracillima* and *L. lævis*.

Lagena gracillima (under one modification or another) occurs on the Norwegian coast and in the Red Sea, on the beach near Melbourne, at Swan River, and on the Australian Coral-reefs. One or two specimens are also reported from the Durham coast.

In the Crag it has hitherto been found only in the Sutton beds. It is not uncommon in the Tertiary marl of Sicily, examined by Prof. Seguenza.

Genus—Nodosarina, *Parker* and *Jones*.

Nautilus, Orthoceras (parte), Orthocera, Nodosaria, Ellipsoidina (?), Glandulina, Mucronina, Lingulina, Fissurina, Amphimorphina, Frondicularia, Flabellina, Dentalina, Dentalinopsis, Vaginulina, Rimulina, Marginulina, Psecadium, Lingulinopsis, Hemicristellaria, Hemirobulina, Saracenaria, Cristellaria, Robulina, Planularia, &c., *Auctorum*.[1]

General characters.—Shell hyaline, tubuliferous, either straight, arcuate, or discospiral; composed of several segments, arranged in one series. Pseudopodial orifice terminal and single, either central or excentric. Surface smooth, or ornamented with straight, raised, parallel lines, either continuous or interrupted, sometimes reduced to spines or granules, sometimes replaced by one or more keels.

Nodosarina (*Marginulina*) *raphanus* is the central form of a large series of Foraminifera, whose constant variation in respect to degree of curvature, excentricity of aperture, with greater or less flatness or compression, has given rise to the most unphilosophical splitting up of what is practically a single species into an almost infinite number of pseudo-specific forms. The so-called genera and subgenera *Glandulina*, *Nodosaria*, *Lingulina*, *Frondicularia*, *Flabellina*, *Rimulina*, *Dentalina*, *Vaginulina*, *Marginulina*, *Planularia*, *Cristellaria*, &c., have in this way all been constituted on characters of scarcely varietal significance. With some exceptions, however, they have a certain value of convenience, which induces us, as in other cases, to admit them as representing divisions or groups in an otherwise unwieldy genus, which have certain peculiarities in common, though it would not be difficult to find a series of specimens which should exhibit every variation, from the straightest and most elongated *Nodosaria* to the most lenticular and carinate *Cristellaria*. We shall speak of these groups as subgenera, for want of a better title.

[1] Ehrenberg applied the term "*Nodosarina*" (Berlin Acad. Transact. for 1838) to a corresponding group of *Foraminifera*, as a Family of the Polythalamian Order of his "*Bryozoa*."

Subgenus—Glandulina, *D'Orbigny.*

Nautilus (Orthoceras), *Batsch.*
Nodosaria (Glandulina), *D'Orbigny, Parker* and *Jones, Carpenter.*
Glandulina, *D'Orbigny, Reuss, Brown, Morris, Bornemann, Brady,* &c.

Characters.—Shell acute-ovate. Chambers few in number, short, subcylindrical, or slightly ventricose; each successive chamber much larger than the preceding one, and embracing a large portion of it. Aperture central.

1. Glandulina lævigata, *D'Orbigny.* Plate I, figs. 1, 2.

Nodosaria (Glandulina) lævigata, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 252, No. 1, pl. 10, figs. 1—3.
Glandulina lævigata, *D'Orb.*, 1846. For. Fos. Vien., p. 29, pl. 1, figs. 4, 5.
— ovula, *Id.* Ib., figs. 6, 7.
— pygmæa, Gl. manifesta, *Reuss,* 1851. Haid. Nat. Abhandl., vol. iv, p. 22, pl. 2, figs. 3, 4.
— rotundata, *Bornemann,* 1854. Liasform. Göttingen, p. 31, pl. 2, figs. 1, 2.
— inflata, *Born.*, 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 16, pl. 1, figs. 6, 7.
— lævigata, *Id.* Ib., fig. 8.
— elongata, *Id.* Ib., fig. 9.
— concinna, *Reuss,* 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 263, pl. 8, fig. 1.
— lævigata, *Neuegeboren,* 1856. Denksch. Math.-Nat. Cl. Akad. Wissen. Wien., vol. xii, p. 67, pl. 1, figs. 3, 4.
— abbreviata, *Id.* Ib., p. 68, pl. 1, fig. 1.
Nodosaria lævigata, *Parker* and *Jones,* 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 280, pl. 10, figs. 6—8.
— glans, *Id.*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 453, pl. 19, fig. 7.
Glandulina elliptica, *Reuss,* 1864. Sitzungsb. Akad. Wien., vol. xlviii, p. 47, pl. 3, figs. 29—31.
— lævigata, *Brady,* 1864. Trans. Linn. Soc., vol. xxiv, p. 468, pl. 48, fig. 7.
— strobilus, *Reuss,* 1865. Denks. Akad. Wien., Math.-Nat. Cl., vol. xxv, p. 20, pl. 2, fig. 24.
— gracilis, *Id.* Ib., p. 21, pl. 2, figs. 25—27.
— lævigata, var. inflata, *Id.* Ib., p. 20, pl. 2, figs. 29—31.
Nodosaria (Glandulina) lævigata, *Parker* and *Jones,* 1865. Phil. Trans., vol. clv, p. 340, pl. 13, fig. 1.
Glandulina annulata, *Stache,* 1865. Novara-Exped., Geol. Theil, part 2, p. 184, pl. 22, fig. 6.
— subovata, *Id.* Ib., p. 185, pl. 22, fig. 7.
— napæformis, *Id.* Ib., p. 186, pl. 22, fig. 8.

Characters.—Shell more or less acutely ovate or subfusiform, composed of short subcylindrical chambers, few in number, and increasing rapidly in size with the growth of the shell. Pseudopodial aperture at the summit of the terminal chamber, usually round, but becoming more slit-like when the chambers become compressed. Surface smooth. The striate variety is known as *Gl. glans*, D'Orb. Length about $\frac{1}{24}$th inch.

Glandulina lævigata is an interesting subtypical form of *Nodosarina*, distinguished from *Nodosariæ* proper by its short, subglobular, fusiform shape. On the other hand, it is frequently almost impossible to separate the Glanduline from the short Linguline varieties of the type, which often differ in nothing save an inappreciable amount of flattening in the shells of the latter.

The specimens from Sutton in Mr. Searles Wood's collection are somewhat above the average size; and, from their number, *Gl. lævigata* appears to have been a tolerably common form in the beds examined by him.

In comparison with the other *Nodosarinæ*, *Glandulina* is nowhere abundant in a recent state. In the muddy bed of the Gulf of Suez at 30 to 40 fathoms, in the Mediterranean at from 30 to 100 fathoms, off Shetland at about 70 fathoms, off the Norwegian coast at a similar depth, and within the Arctic Circle at 160 fathoms, it is to be found sparingly distributed.

It is less rare in a fossil condition, though the examples are generally very small, and may be met with in the Upper Triassic Clay of Chellaston, in many Liassic marls, in the Oxford Clay of Leighton-Buzzard, the Kimmeridge Clay of Aylesbury, in the Chalk-marl of the South-east of England, and in the Tertiaries of Europe, New Zealand, &c.

Subgenus—NODOSARIA, *Lamarck*.

NAUTILUS, *Linné, Schroeter, Walker, Gmelin, Batsch, Turton, Montagu, Maton* and *Rackett, Pennant, Dillwyn, Wodarch, W. Wood*, &c.
ORTHOCERAS, *Gualtieri, Martini, Batsch, De Blainville, Hanley*, &c.
ORTHOCERA, *Lamarck, Brookes, De Blainville, Crouch, Brown, Fleming, Thorpe*, &c.
NODOSARIA, *Lamarck, Defrance, D'Orbigny, Nilsson, Crouch, Brown, Sowerby, Dujardin, Hisinger, Roemer, Geinitz, Hanley, Ehrenberg, Michelotti, Hagenow, Morris, Thorpe, Philippi, Reuss, Czjzek, Bronn, M'Coy, Bailey, Eichwald, Bornemann, Schultze, Neuegeboren, Egger, Parker* and *Jones, Williamson, Terquem, Costa, Karrer, Carpenter, Brady, Stache*, &c.

General characters.—Shell cylindrical, composed of several nearly equal segments, arranged in a straight series; either smooth or ornamented with ribs, granules, or spines; septal lines more or less depressed, making constrictions at right angles to the long axis of the shell. Pseudopodial aperture simple, central, often pouting.

1. NODOSARIA RAPHANUS, *Linné*, sp. Plate I, figs. 4, 5, 22, 23.

Cornu Hammonis erectum, &c., *Plancus*, 1739. Conchis minus notis, p. 15, pl. 1, figs. 6, D—H.
Orthoceras minimum, &c., *Gualtieri*, 1742. Index Test., pl. 19, figs. L, L, LL, M.
NAUTILUS RAPHANUS, *Linné*, 1758. Syst. Nat., 10th ed., p. 711, No. 243; 1767, Syst. Nat., 12th ed., p. 1164, No. 283.
Cornu Ammonis, &c., *Ledermüller*, 1760. Mikroskop. Gemuths., &c., p. 9, pl. 4, figs. *x*, *x*.
ORTHOCERAS, *Martini*, 1769. Neu. Syst. Konch. Kab., vol. i, p. 1 and p. 34, vignette 1, figs. A, B, C.
ORTHOCERA RAPHANOIDES, *Lamarck*, 1801. Syst. des Anim., p. 103.
NAUTILUS (ORTHOCERAS) COSTATUS, *Batsch*, 1791. Conchyl. Seesand., pl. 1, figs. 1 *a*—1 *g*.
— COSTATUS, *Montagu*, 1803. Test. Brit., vol. i, p. 199, pl. 14, fig. 5.
ORTHOCERA RAPHANUS, *Lamarck*, 1816. Encycl. Méth., pl. 465, figs. 2 *a*, *b*, *c*; 1822, Anim. sans Vert., vol. vii, p. 593, No. 1.
NAUTILUS RAPHANUS, *Dillwynn*, 1817. Descript. Cat. Rec. Shells, vol. i, p. 347.
NODOSARIA ACICULA, *Lamarck*, 1822. Anim. sans Vert., vol. vii, p. 594, No. 5.
— LAMELLOSA, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 253, No. 17, pl. 10, figs. 4—6.
— RAPA, *Id.* Ib., No. 27.
ORTHOCERA RAPHANUS, *Crouch*, 1827. Illust. Introd. Conch., p. 39, pl. 20, fig. 5.
NAUTILUS RAPHANISTRUM, N. RAPHANUS, *W. Wood*, 1828. Suppl. Index Test., p. 64, pl. 13, figs. 23, 24.
ARTICULINA, *Wetherell* and *Sowerby*, 1834. Trans. Geol. Soc., 2nd ser., vol. v, p. 135, pl. 9, fig. 10.
NODOSARIA PAUCICOSTATA, *Roemer*, 1840. Verst. Nordd. Kreid., p. 96, pl. 15, fig. 7.
— TENUICOSTA, *Reuss*, 1845. Verst. Böhm. Kreid. I, p. 25, pl. 13, figs. 5, 6.
— OBSCURA, *Id.* Ib., p. 26, pl. 13, figs. 7—9.
— SULCATA, *Id.* Ib., p. 26, pl. 13, fig. 17.
— BOLLI, *Reuss*, 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 262, pl. 8, fig. 6.
ORTHOCERA RAPHANUS, *Hanley*, 1855. Ipsa Linn. Conch., p. 159.
— RAPHANISTRUM, O. RAPHANUS, *Hanley*, 1856. Wood's Index Test., p. 74, pl. 13, figs. 23, 24.
DENTALINA SUBARCUATA, var. JUGOSA (parte), *Williamson*, 1858. Rec. Fos. Gr. Brit., p. 20, pl. 2, fig. 43.
NODOSARIA RAPHANUS, *Parker* and *Jones*, 1859. Ann. N. Hist., 3rd ser., vol. iii, p. 477, &c.; 1865, Phil. Trans., vol. clv, p. 340, pl. 16, fig. 1.
DENTALINA PULCHRA, *Gabb*, 1860. Journ. Acad. Sc. Philadelphia, new series, vol. iv, part 4, p. 402, pl. 69, figs. 40, 41.
NODOSARIA DUPLICOSTATA, *Reuss*, 1860. Sitz. Akad. Wien., vol. xl, p. 179, pl. 1, fig. 5.
— RAPHANUS, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473.
— STRIATISSIMA, *Stache*, 1865. Novara-Exped., Geol. Theil, I Band, II Abtheil., p. 198, pl. 22, fig. 25.

Dentalina striatissima, *Stache*, 1865. Novara-Exped., Geol. Theil, I Band, II Abtheil., p. 200, pl. 22, fig. 38.

Nodosaria (Dentalina) Ludwigi, *Reuss*, 1866. Denks. Math.-Nat. Cl. Akad. Wissen., vol. xxv, p. 19, pl. 2, fig. 23.

Characters.—Shell straight, subcylindrical, tapering, composed of a few largish chambers, and externally ribbed from end to end by stout parallel ridges. The constrictions marking the septal lines are sometimes concealed by the overgrowing longitudinal costæ. Liable to become either curved or compressed, or both, with more or less excentric aperture; and thereby passing into either *Dentalina* or *Marginulina*.

Length $\frac{1}{30}$th to $\frac{1}{4}$th inch and more.

It would be impossible to define exactly the limits between *Nodosaria raphanus* and the two forms which follow it on our list, *N. raphanistrum* and *N. scalaris*. All are straight Nodosarians, and have longitudinal costæ. That there is a considerable amount of varietal distinction, the examination of a few specimens of each would satisfy any observer, and is confirmed by the peculiarities of distribution. In general terms, we may say that the species now under consideration (*N. raphanus*) is the bold, few-chambered, coarse-ribbed, and tapering form; *N. raphanistrum* is a longer and more cylindrical shell, with a larger number of segments, and the ribs more neatly put on; and *N. scalaris* is a few-chambered, more delicate, and transparent shell, seldom growing to a large size, and commonly having an extended neck produced from the terminal chamber.

A specimen from Sutton (Lower Crag) and one from Thorpe (Upper Crag) are the only evidences we have of this species in the Crag; nor is it an abundant form anywhere, except in the Adriatic, where it is frequently Marginuliniform (like our fig. 21), and is associated with arcuate or Dentaline varieties.

In the Lias clays *N. raphanus* is sparingly found where the other *Nodosarinæ* are very common; and in other Secondary and many Tertiary formations it is to be met with.

Professor Williamson figures a broken specimen (fig. 43) from the British seas, but does not give the locality; and we have one or two examples from deep water (70 to 80 fathoms) off Shetland, and several from a similar or greater depth in the Hebrides. It occurs in the North Atlantic (78 fathoms); South Atlantic (Abrolhos Bank, 260 fathoms); and in the Mediterranean and Adriatic seas; but well-developed specimens are rare.

2. Nodosaria raphanistrum, *Linn.*, sp. Plate I, figs. 6—8.

Nautilus raphanistrum, *Linn.*, 1758. Syst. Nat., 10th ed., p. 710, No. 242; 1767, Syst. Nat., 12th ed., p. 1163, No. 282.

Nautilus costatus, var., *Montagu*, 1808. Test. Brit. Supp., p. 83, pl. 19, fig. 2.

Orthocera raphanistrum, *Lamarck*, 1822. An. s. Vert., p. 594, No. 3.

— — *De Blainville*, 1824. Dict. Sc. Nat., vol. xxxvi, p. 486.

Nodosaria Bacillum, *Defrance*, 1825. Ib., vol. xxxv, p. 127; vol. xxvi, p. 487, Atlas Conch., pl. 13, fig. 4.

Nodosaria Bacillum, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 254, No. 34.

Orthocera, *Woodward*, 1833. Geol. Norfolk, pl. 6, fig. 24.

Articulina, *Wetherell* and *Sowerby*, 1834. Trans. Geol. Soc., 2nd ser., vol. v, p. 135, pl. 9, fig. 9.

Nodosaria, *Dujardin*, 1835. Mém. Soc. Géol. Fr., vol. ii, p. 310, pl. 17, fig. 17.

— filiformis, 1837. Henderson's Edition of Cuvier's 'Animal Kingdom,' vol. iii, pl. 8, fig. 10.

— undecimcostata, N. septemcostata, *Geinitz*, 1839. Charact. Sächs. Kreid., p. 69, pl. 17, figs. 19, 20.

— æqualis, *G. Sowerby*, 1839. Conchol. Manual, p. 71, fig. 465.

— acicula, N. elegans, N. Ranzanii, N. clava, *Michelotti*, 1841. Rizopodi Terreni Sopracret. (Mem. Fissica Soc. Ital., vol. xxii, p. 302, pl. 1, figs. 1—4.

— Zippei, *Reuss*, 1844 (?). Kreidegebirg., p. 210; 1845, Verst. Böhm. Kreid. I, p. 25, pl. 8, figs. 1—3.

— paupercula, *Id.*, 1845. Ib., p. 26, pl. 12, fig. 12.

— bacillum, *D'Orb.*, 1846. For. Foss. Vien., p. 40, pl. 1, figs. 40—47.

— affinis, *Id.* Ib., p. 39, pl. 1, figs. 36—39.

— raphanistrum, *Michelotti*, 1847. Foss. Mioc. Ital. Septent. (Nat. Verhandl. Hollandsch. Maatschap. Wetenschap. Haarlem. Tweede Verzam., 3e Deel. 2e Stuk. 1847), p. 12, pl. 1, fig. 7.

— enneagona, *Alex. Rouault*, 1850. Mém. Soc. Géol. France, 2nd ser., vol. iii, p. 466, pl. 14, figs. 12, 12 *a*.

Orthocera raphanistrum, *Hanley*, 1855. Ipsa Linn. Conch., p. 159, pl. 5, fig. 4.

Nodosaria distans, *Reuss*, 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 264, pl. 8, fig. 5.

— polygona, *Id.* Ib., figs. 7, 8.

— compressiuscula, *Neuegeboren* (in part), 1856. Denks. Math.-Nat. Cl. K. Akad. Wiss. Wien., vol. xii, p. 79, pl. 2, figs. 1—7.

Dentalina subarcuata, var. jugosa (parte), *Williamson*, 1858. Rec. For. Gt. Br., p. 20, pl. 2, fig. 44.

Nodosaria intercostata, *Reuss*, 1860. Sitz. Akad. Wien., Math.-Nat. Cl., vol. xl, p. 179, pl. 1, fig. 4.

— prismatica, *Id.* Ib., pl. 2, fig. 2.

— raphanus, *Parker* and *Jones*, 1860. Q. J. Geol. Soc., vol. xvi, p. 453, pl. 19, fig. 10.

— spectrum, *Reuss*, 1862. Sitz. Akad. Wien., Math.-Nat. Cl., vol. xlvi, p. 37, pl. 2, fig. 3.

— tubifera, *Id.* Ib., fig. 4.

— bactroides, *Id.* Ib., fig. 5.

— lamelloso-costata, *Id.* Ib., p. 38, pl. 2, fig. 6.

— prismatica, *Id.* Ib., p. 36, pl. 2, fig. 7.

— mutabilis, *Costa* (n. d.). Foram. Foss. Terziar. Messina, p. 8, pl. 1, figs. 1, 2.

— sulcata, *Id.* Ib., p. 14, pl. 1, fig. 4.

— subsimilis, *Stache*, 1865. Novara-Exped., Geol. Theil, I Band, II Abtheil., p. 195, pl. 22, fig. 21.

NODOSARIA SUBSTRIGATA, *Stache*, 1865. Novara-Exped., Geol. Theil, I Band, II Abtheil., p. 196, pl. 22, fig. 22.
— CALLOSA, *Id.* Ib., p. 197, pl. 22, fig. 23.
— OBLIQUECOSTATA, *Id.* Ib., fig. 24.
— BIFORMIS, N. BACTRIDIUM, *Reuss*, 1866. Denks. Akad. Wien., vol. xxv, p. 14, pl. 1, figs. 23—25.
— CONSPURCATA, *Id.* Ib., pl. 2, figs. 19—24.

Characters.—Shell long, straight, cylindrical, many-chambered; septa more or less constricted; surface ornamented by numerous stout parallel ribs running from end to end of the shell. Length $\frac{1}{10}$th inch to 1 inch and more.

This is the most perfect form of all the straight *Nodosariæ*. When well grown it is a large stout shell, with well-marked characteristic parallel ribs. Taking a curved growth, it becomes *Dentalina obliqua*, Linn.

N. raphanistrum is rare in the Crag at Sutton. It occurs in the Upper Trias, in the Upper, Middle, and Lower Lias, in the Oxford and Kimmeridge Clays, in the Gault and Chalk, in the London Clay, and in various more recent Tertiary clays, such as those of Italy, Spain, and San Domingo. Recent specimens are of rarer occurrence, but are occasionally met with in company with other *Nodosariæ* in the Mediterranean and other seas.

3. NODOSARIA SCALARIS, *Batsch*, sp. Plate IV, fig. 8.

NAUTILUS (ORTHOCERAS) SCALARIS, *Batsch*, 1791. Conchyl. Seesands, pl. 2, figs. 4 *a*, *b*.
NODOSARIA LONGICAUDA, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 254, No. 28; Soldani, Testac., vol. ii, pl. 95, figs. B, M.
ARTICULINA, *Wetherell* and *Sowerby*, 1834. Trans. Geol. Soc., ser. 2, vol. v, p. 135, pl. 9, fig. 8.
NODOSARIA STRIATICOLLIS, *D'Orb.*, 1839. For. Canaries, p. 124, pl. 1, figs. 2—4.
— CANDEI, *Id.*, 1840. For. Cuba, p. 44, pl. 1, figs. 6, 7.
— CATESBYI, *Id.* Ib., p. 45, pl. 1, figs. 8—10.
— INFLATA, *Reuss*, 1845. Verst. Böhm. Kreid. I, p. 25, pl. 13, figs. 3, 4; 1855, Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 262, pl. 8, fig. 2.
— BADENENSIS, *D'Orb.*, 1846. For. Foss. Vien., p. 38, pl. 1, figs. 34, 35.
— PROBOSCIDEA, *Reuss*, 1850. Haiding. Nat. Abhand., vol. iv, p. 23, pl. 2, fig. 6.
— VENUSTA, *Reuss*, 1850. Denks. Akad. Wien., vol. i, pl. 46, fig. 5.
LAGENA WILLIAMSONI (?), *Harvey* and *Bailey*, 1853. Proc. Acad. Philadelphia, vol. vi, p. 431.
DENTALINA INFLATA, *Reuss*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 262, pl. 8, figs. 2—4.
NODOSARIA BADENENSIS, var. ACULEATA, *Egger*, 1857. Foram. Miocän-Schicht. Nieder-Bayern, p. 52, pl. 11, figs. 17—21.

NODOSARIA SIMONIANA, *Terquem*, 1858. Mém. Acad. Metz, Année xxxix, p. 587, pl. 1, figs. 4 *a*, *b*.
— PRIMA, *Id.* Ib., p. 589, pl. 1, figs. 6 *a*, *b*.
— RADICULA, *Williamson*, 1858. Rec. For. Gt. Br., p. 15, pl. 2, figs. 36—38.
— NANA, *Reuss*, 1860. Sitz. Akad. Wien., vol. xl, p. 35, pl. 1, fig. 6.
— LONGICAUDA, *Parker* and *Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302; 1862, in Carpenter's Introd., Append., p. 310.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473.
— SCALARIS, *P.*, *J.*, and *Brady*, 1865. Ann. Nat. Hist., 3rd ser., vol. xv, p. 227.
— — *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 340, pl. 16, figs. 2 *a*—*c*; pl. 18, fig. 13.
— ANNULATA, *Costa* (n. d.) Foram. Foss. Terz. Messin., p. 13, pl. 1, fig. 16.

Characters.—Shell straight, generally composed of from two to five chambers. Second chamber often smaller than the first, otherwise each succeeding chamber larger than that immediately preceding it. Chambers ventricose. Ornamentation, a number of neat parallel costæ, generally continuous from end to end of the shell. Pseudopodial aperture at the summit of the elongated neck of the ultimate segment, and often lipped.

This is a common variety of *Nodosaria*, of altogether feebler growth, and having fewer chambers, than *N. raphanius;* the shell, too, is thinner and more hyaline. The specimen from which our figure is taken is a very small, two-chambered, unique individual from the Bridlington Crag, in Mr. H. C. Sorby's collection.

N. scalaris is the most common recent *Nodosaria*, and it is found sparingly in all temperate and tropical seas. Its geological distribution is similar to that of *N. raphanus*, being known in the Secondary formations, and occurring in various strata up to the later Tertiary clays, in which it is not uncommon.

Subgenus—DENTALINA, *D'Orbigny*.

ORTHOCERAS, *Gualtieri*, *Martini*.
NAUTILUS, *Linné*, *Schröter*, *Batsch*, *Gmelin*, *Turton*, *Montagu*, *Maton* and *Rackett*, *Pennant*, *Dillwyn*, *Wodarch*.
ORTHOCERA, *Lamarck*, *Brown*, *Fleming*, *Hanley*, *Thorpe*.
NODOSARIA, *Lamarck*, *Defrance*, *D'Orbigny*, *Brown*, *Nilsson*, *Hisinger*, *Münster* and *Roemer*, *Michelotti*, *Parker* and *Jones*, *Reuss*, *Carpenter*.
DENTALINA, *D'Orbigny*, *Risso*, *Bronn*, *Ehrenberg*, *Macgillivray*, *S. Wood* and *Morris*, *Reuss*, *Czjzek*, *Alth*, *Cornuel*, *Jones*, *Bayley*, *Eichwald*, *Schultze*, *Bornemann*, *Parker* and *Jones*, *Williamson*, *Terquem*, *Neuegeboren*, *Karrer*, *Brady*, *Stache*.

General characters.—Shell awl-shaped, subcylindrical, tapering, curved; composed

of several chambers in a linear series; the primordial segment often very small. Septal lines either straight or oblique; usually constricted, occasionally level with the surface. Aperture terminal, often pouting, and nearly always excentric. *Dentalina* is not separable from *Nodosaria, Vaginulina,* and *Marginulina,* except artificially; for they all pass one into the other by numerous gradations.

DENTALINA OBLIQUA, *Linné*. Plate I, fig. 9.

Orthoceras minimum, &c., *Gualtieri*, 1742. Index Test., pl. 19, fig. NN.
NAUTILUS OBLIQUUS, *Linné*, 1767. Syst. Nat., ed. 12, p. 1163, No. 281.
— JUGOSUS, *Montagu*, 1803. Test. Brit., vol. i, p. 198, pl. 14, fig. 4.
NODOSARIA SULCATA, *Nilsson*, 1825. Trans. Acad. Stockholm, p. 341; 1827, Petref. Suecana, p. 8, pl. 9, fig. 19; *Hisinger*, Leth. Suec., 1837, p. 33, pl. 10, fig. 4 (few-ribbed).
— ELEGANS, *Münster*, 1838. Neues Jahrb., 1838, p. 382, pl. 3, fig. 1.
— (DENTALINA) SULCATA, *D'Orb.*, 1840. Mém. Soc. Géol. Fr., vol. iv, p. 15, pl. 1, figs. 10—13.
— — MULTICOSTATA, *Id.* Ib., p. 15, pl. 1, figs. 14, 15 (many-ribbed).
DENTALINA JUGOSA, *S. Wood*, 1843. Morris's Cat. Brit. Foss., p. 61.
NODOSARIA ZIPPEI (parte), *Reuss*, 1845. Verst. Böhm. Kreid. I, p. 25, pl. 8, fig. 1.
— AFFINIS, *Id.* Ib., pl. 13, fig. 16.
— COSTELLATA, *Id.* Ib., fig. 18.
DENTALINA URNULA, *D'Orb.*, 1846. For. Foss. Vien., p. 54, pl. 2, figs. 31, 32 (Dentaline form of *Nodosaria scalaris*).
— ELEGANTISSIMA, *Id.* Ib., p. 55, pl. 2, figs 33—35 (few-ribbed).
— BIFURCATA, *Id.* Ib., p. 56, pl. 2, fig. 38, 39.
— ACUTA, *Id.* Ib., figs. 40—43.
— PRIMÆVA, *D'Orb.*, 1850. Prod. Paléont., vol. i, p. 242, No. 260.
— SEMINUDA, *Reuss*, 1850. Denks. Akad. Wien., vol. i, p. 368, pl. 46, fig. 9.
— BIFURCATA, *Id.* Ib., fig. 10.
— ACUTICOSTA, *Id.* Ib., p. 369, pl. 16, fig. 11.
— KINGII, *Jones*, 1850. King's Monogr. Permian Foss., p. 17, pl. 6, figs. 2, 3.
— PUNGENS, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii, p. 63, pl. 3, fig. 13.
— MUENSTERI, *Reuss*, 1855. Sitz. Akad. Wien., vol. xviii, p. 31, pl. 1, fig. 8.
— LONGICAUDA, *Id.* Zeitsch. Deutsch. Geol. Gesell., vol. vii, p. 267, pl. 8, fig. 12.
— ACUTISSIMA, *Id.* Ib., pl. 8, fig. 13.
— STEENSTRUPI, *Id.* Ib., p. 268, pl. 8, fig. 14 *a*.
— SULCATA, *Id.* Ib., fig. 14 *b*.
— BALTICA, *Id.* Ib., p. 269, pl. 8, fig. 15.

DENTALINA ACUTICOSTA, D. BIFURCATA, D. MULTILINEATA, *Bornemann*, 1855. Zeits. Deut. Geol. Ges., vol. vii, p. 325, pl. 13, figs. 9—12.
— CREBICOSTATA, *Neuegeboren*, 1856. Denks. Akad. Wissen. Math.-Natur. Cl., vol. xii, p. 90, pl. 4, figs. 12, 13.
— LAMARCKI, *Id.* Ib., p. 91, pl. 4, figs. 16 *a*, 16 *b*.
— PRIMÆVA, *Terquem*, 1858. Mém. Acad. Imp. Metz., 39 année, p. 603, pl. 2, figs. 12 *a*, *b*.
— SUBARCUATA, var. JUGOSA (parte), *Williamson*, 1858. Rec. For. Gt. Br., p. 20, pl. 2, fig. 42.
NODOSARIA RAPHANUS, var. OBLIQUA, *Parker* and *Jones*, 1859. Ann. Nat. Hist., ser. 3, vol. iv, p. 351.
DENTALINA MARCKI, *Reuss*, 1860. Sitz. Akad. Wien., vol. xl, p. 188, pl. 2, fig. 7.
— POLYPHRAGMA, *Id.* Ib., p. 189, pl. 3, fig. 1.
— KONINCKI, D. MICROPTYCHA, D. ARCUATA, *Id.* Ib., vol. xlii, p. 356, &c., figs. 3—5.
— CONFLUENS, *Reuss*, 1861. Ib., vol. xliv, p. 335, pl. 7, fig. 5.
NODOSARIA SIPHUNCULOIDES, *Costa* (n. d.). Foram. Foss. Marne Terziar. Messina, p. 9, pl. 1, fig. 27.
DENTALINA MARTINI, *Terquem*, 1862. Mém. Acad. Imp. Metz, 43 année, p. 454, pl. 6, fig. 14.
— ACICULA, *Parker* and *Jones*, 1862. In Carpenter's Introd., Append., p. 310.
— LINEATA, *Reuss*, 1864. Sitz. Akad. Wiss. Math.-Natur. Cl., vol. l, 1 Abth., p. 22, pl. 4, fig. 11.
— ACICULA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473.
— SCHWARZII, *Karrer*, 1864. Sitzung. Akad. Wien., vol. l, 1 Abtheil., p. 15, pl. 1, fig. 5.
— OBSCURA, *Stache*, 1865. Novara-Exped., Geol. Theil, part 2, p. 208, pl. 22, fig. 37.
NODOSARIA (DENTALINA) PUNGENS, *Reuss*, 1866. Denks. Akad. Wissen. Math.-Natur. Cl., vol. xxv, p. 19, pl. 2, fig. 16.

Characters.—Shell elongated, arcuate, tapering; composed of numerous (six to fifteen) chambers, which are subcylindrical and more or less ventricose, with the septal lines generally constricted, and the surface covered with riblets, varying in number and size in different specimens. Length $\frac{1}{10}$th to $\frac{4}{10}$ths inch.

Dentalina obliqua may be regarded as the curved form of *Nodosaria raphanistrum.* Like the latter, it has usually a large number of chambers, and it is covered with similar parallel longitudinal ribs, and under favorable circumstances it attains to similarly large dimensions, the only difference being a more or less curved mode of growth. Some specimens seem rather to be the curved forms of *N. raphanus;* but there is little or no real difference. The *straight* tapering variety of *N. raphanistrum* is *N. acicula,* Lamarck.

Mr. Searles Wood's specimens from Sutton are fine and numerous; but we have not obtained it from other Crag beds. It is not an uncommon form in the various Secondary

and Tertiary fossiliferous clays. It occurs in the Lias, in the Chalk, and in the more recent formations of countries bordering on the Mediterranean.

Living specimens have been found on our own coast, in the Mediterranean (320 fathoms), and in the Indian Ocean (1120 fathoms); but it can scarcely be looked upon as a common recent species.

DENTALINA OBLIQUESTRIATA, *Reuss.* Plate I, fig. 19.

DENTALINA MATUTINA, *D'Orb.*, 1850. Prodrome Paléont., p. 242, No. 259.
— OBLIQUESTRIATA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesell., vol. iii, p. 63, pl. 3, figs. 11, 12.
— GEINITZIANA, *Neugeboren*, 1856. Denks. Akad. Wien. Math.-Natur. Cl., vol. xii, p. 91, pl. 4, fig. 15.
— — *Terquem*, 1858. Mém. Acad. Imp. Metz., 39 année, p. 602, figs. 11 *a*, *b*.
— DIVERGENS, *Reuss*, 1864. Sitz. Akad. Wissen. Math.-Natur. Cl., vol. l, 1 Abtheil., p. 22, pl. 4, fig. 10.

Characters.—The same as those of *D. obliqua*, except that the striæ, which in *D. obliqua* are parallel to the longitudinal axis of the shell, take an oblique direction in *D. obliquestriata*. Length $\frac{1}{10}$th inch.

The artificial division which it has been necessary to adopt in reference to the nomenclature of the *Nodosarinæ* renders the trivial name given by Prof. Reuss applicable as a subvarietal distinction to the curved (Dentaline) specimens with oblique striæ, although as early as 1791 straight (Nodosarian) forms similarly marked were figured by Batsch with the specific name "*obliquata*." The straight and the curved specimens have the same kind of costation, and are not really distinct specifically, much less generically.

There have been specimens figured, under various names, in which the oblique striæ are interrupted and partial (like those on the congeneric *Vaginulinæ* shown by our Plate I, fig. 10).

Occasional specimens of this obliquely ribbed form are met with wherever *Nodosarinæ* are abundant; but it is nowhere common, and we are not aware that it has been found in a recent condition.

Dentalina communis, *D'Orbigny*.

Under the name of *Nodosaria* (*Dentalina*) *communis* D'Orbigny has placed two varieties of smooth, tapering, curved *Nodosariæ*, one having *straight* and the other *inclined* septa. Both of these conditions (the septal planes being in one case at right angles to the axis of the shell, and in the other oblique) occur together in very many specimens of such *Dentalinæ*, and therefore can be accepted only as artificial means of distinction. Moreover, the relative length and convexity of the segments are extremely variable, even in one and the same specimen; and the length, also, and curvature of the shell, and its departure from the cylindrical form, are all unstable characters. It results that all these varieties (almost as numerous as the individuals) can be grouped either under "*Nodosaria dentalina*" of Lamarck, or the better known name "*Dentalina communis*," D'Orbigny. For convenience, we may keep the oblique-chambered specimens separate from the others when it preponderates over the other character.

The modifications of the *Dentalinæ* having straight septa are more numerous than the others, as the latter, or oblique forms, soon become more definitely characterised as "*Vaginulinæ*" and "*Marginulinæ*."

There are, however, other varieties of smooth *Dentalinæ*, many specimens having globose chambers (*D. radicularis*, Münster, &c.), and others having swollen but long segments (*D. globifera*, Batsch, &c.).

These smooth *Dentalinæ* are really tapering and curved sub-varieties of *Nodosaria radicula;* the ornamented individuals belonging to *N. raphanus;* and the obliquity of the segments and departure from axial symmetry culminating in the closely coiled and discoidal *Cristellariæ*.

Among the numerous Dentaline sub-varieties of *Nodosaria raphanus* (*Dentalina obliqua*, Linn., being the first in order) every modification of *N. raphanus* has its Dentaline representative, whether the riblets be general or partial, few or many, coarse or fine, straight or oblique, continuous or interrupted, obsolete or replaced by spines or granules. So also there are Vaginuline, Marginuline, Cristellarian, Frondicularian, and other modifications, respectively smooth (after the habit of *N. radicula* and its congeners), or ornamented (after any of the patterns adopted by *N. raphanus* in its variations). As *Marginulina raphanus* is the central form of all these modifications of one type, we have chosen it (as *Nodosarina raphanus*, typica) as the zoological representative of the group.

It is inconvenient at present to construct a scheme of the alliances of the chief Nodosarine forms; and even for the *Nodosariæ* alone it would be almost a vain labour to attempt it, as they all mutually graduate one into the other—*Glandinulinæ*, *Lingulinæ*, *Dentalinæ*, *Vaginulinæ*, *Marginulinæ*, &c., having full participation in all the characters

of *Nodosariæ,* and hybrid individuals being almost as common as any of the so-called typical varieties.

Dentalinæ with a central aperture (Pl. I, fig. 9, for instance) are merely bent *Nodosariæ.* When the aperture is excentric, and the shell is tapering and curved, we have a "*Dentalina*" if it be round in transverse section, and "*Vaginulina*" if it be compressed. But often a shell is Vaginuline (compressed) in its early growth and Dentaline when old, and this is the case with fig. 10, a Dentaline form of *Vaginulina linearis.* The compressed forms are often straight, and therefore most of the *Vaginulinæ* are straight rather than curved. If in a compressed shell, stouter than the tapering forms, and commencing with a relatively larger segment, or with coiled segments, the septal apertures follow the convex margin, we have a "*Marginulina*" (fig. 36); and a stout Nodosarian shell, circular in section, and with its septal apertures marginal, is also a "*Marginulina*" (Pl. I, fig. 21). If, however, these straight, stout, oblique-chambered *Nodosarinæ,* with marginal aperture, be much compressed at the edges (being then acute-oval in transverse section), they pass as *Vaginulinæ* (Pl. IV, fig. 9).

It is very difficult, therefore, to place all straight Nodosarian specimens definitely in one or other of these groups, which are quite artificial; for Marginuline and Dentaline forms of *Nodosaria raphanus* (compare Pl. I, figs. 4, 9, 19, 21) and similar conditions of *N. radicula* abound, wandering from *Glandulinæ* and *Lingulinæ* to *Cristellariæ,* *Flabellinæ,* &c., without any real zoological distinction.

Dentalina communis, *D'Orbigny.*

a. With straight septal planes. Plate I, figs. 13—18, 20; Plate IV, fig. 10.

Nautilus (Orthoceras) leguminiformis (parte), *Batsch,* 1791. Conch. Seesand., pl. 3, fig. 8 *b.*

— rectus, *Montagu,* 1808. Test. Brit. Supplem., p. 82, pl. 19, figs. 4, 4', 7.

Nodosaria dentalina, *Lamarck,* 1822. Anim. sans Vert., vol. vii, p. 596, No. 2.

— lævigata, *Nilsson,* 1825. Act. Acad. Holm., 1825, p. 342; 1827, Petrif. Suec., p. 8, pl. 20, fig. 20.

— (Dentalina) communis, *D'Orb.,* 1826. Ann. Sc. Nat., vol. vii, p. 254, No. 35; after Soldani, Testac., vol. ii, pl. 105, fig. o. (Montagu's *N. rectus* is catalogued by D'Orbigny as var. *a* of this species.)

— lævigata, *Hisinger,* 1837. Lethæa Suecica, p. 33.

— (Dentalina) gracilis, *D'Orb.,* 1840. Mém. Soc. Géol. France, vol. iv, p. 14, pl. 3, fig. 5.

— — nodosa, *Id.* Ib., figs. 6, 7.

— — Lorneiana, *Id.* Ib., figs. 8, 9.

— linearis, *Roemer,* 1840. Verst. Nordd. Kreid., p. 95, pl. 15, fig. 5.

DENTALINA CLAVA, D. ATTENUATA, *S. Wood*, 1843. Morris's Catal. Brit. Foss., p. 61.
NODOSARIA LORNEIANA, *Reuss*, 1845. Verst. Böhm. Kreid., part 1, p. 27, pl. 8, fig. 5.
— GRACILIS, *Id.* Ib., fig. 6.
— ANNULATA, *Id.* Ib., pl. 13, fig. 21.
DENTALINA OLIGOSTEGIA, *Id.* Ib., p. 29, pl. 13, figs. 19, 20; 1851, Haiding. Abhandl., vol. iv, p. 19, pl. 2, fig. 10.
— ELEGANS, *D'Orb.*, 1846. For. Foss. Vien., p. 45, pl. 1, figs. 52—56.
— PAUPERATA, *Id.* Ib., p. 46, pl. 1, figs. 57, 58.
— CONSOBRINA, *Id.* Ib., pl. 2, figs, 1—3.
— BOUEANA, *Id.* Ib., p. 47, pl. 2, figs. 4—6.
— VERNEUILII, *Id.* Ib., p. 48, pl. 2, figs. 7, 8.
— BREVIS, *Id.* Ib., figs. 9, 10.
— PUNCTATA, *Id.* Ib., p. 49, pl. 2, figs. 14, 15.
— *Williamson*, 1847. Microp. Obj. Levant, p. 78, pl. 4, figs. 70, 72.
— INERMIS, *Czjzek*, 1848. Haidinger's Naturw. Abhandl., vol. ii, p. 138, pl. 12, figs. 3—7.
MARGINULINA CONTRARIA, *Id.* Ib., p. 140, pl. 12, figs. 17—20.
DENTALINA MONILE, *Cornuel*, 1848. Mém. Soc. Géol. France, ser. 2, vol. iii, p. 247, pl. 1, fig. 18.
— ANTENNA, D. INTERMEDIA, D. CHRYSALIS, *Id.* Ib., figs. 19—21.
— TRICHOSTOMA, *Reuss*, 1850. Denksch. k. k. Akad. Wiss. Wien., vol. i, pl. 46, fig. 6.
— TERQUEMI, *D'Orb.*, 1850. Prodrôme Pal., vol. i, p. 242, No. 257.
— ANNULATA, *Alth*, 1850. Haidinger's Abhandl., vol. iii, p. 270, pl. 13, fig. 29.
— PERMIANA, *Jones*, 1850. King's Monogr. Perm. Foss., p. 17, pl. 6, fig. 1.
— SUBNODOSA, *Reuss*, 1851. Haidinger's Naturw. Abhandl., vol. iv, p. 18, pl. 2, fig. 9.
— MARGINULOIDES, *Id.* Ib., p. 19, pl. 2, fig. 12.
— ANNULATA, *Id.* Ib., fig. 13.
— LEGUMEN, *Id.* Ib., fig. 14.
— MUTABILIS, *Bailey*, 1851. Smithsonian Contrib., 1861, vol. ii, pl. 1, fig. 7.
— DISPAR, D. ACUTICAUDA, D. EMACIATA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii, p. 52, pl. 3, figs. 7—9.
— OBTUSATA, *Id.* Ib., p. 151, pl. 8, fig. 1.
— ENSIS, D. IRREGULARIS, *Eichwald*, 1852. Lethæa Rossica, part 1, p. 9, pl. 1, figs. 6 *a*, 6 *b*.
— PLEBEIA, D. MEGALOPOLITANA, D. TENUICOLLIS, *Reuss*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 267, pl. 8, figs. 9—11
— CONSOBRINA, *Bornemann*, 1855. Ib., p. 323, pl. 13, figs. 1—4.
— ELEGANS, D. PAUPERATA, D. VERNEUILII, *Id.* Ib., figs. 6—8.
MARGINULINA TENUIS, *Id.* Ib., p. 14.
DENTALINA REUSSI, *Neuegeboren*, 1856. Denks. Akad. Wiss., vol. xii, p. 85, pl. 3, figs. 6, 7.
— PYGMÆA, *Id.* Ib., fig. 9.
— HAIDINGERI, *Id.* Ib., fig. 12.
— CONSOBRINA, *Egger*, 1857. For. Mioc. Ortenburg, p. 54, pl. 11, figs. 22, 23.
— TERQUEMI *Terquem*, 1858. Mém. Acad. Imp. Metz, 39 annee, p. 596, pl. 2, figs. 1, 23 (= *D. pauperata*, D'O.).

Dentalina obscura, *Terquem*, 1858. Mém. Acad. Imp. Metz, 39 année, p. 597, pl. 2, fig. 2 (= *D pauperata*, D'O.).

— acuminata, D. cylindroides, D. cognata, D. subrecta, *Reuss*, 1860. Sitzungsb. Akad. Wien., vol. xl, p. 37, &c., pl. 1, figs. 7—10.

— tenuicaudata, D. commutata, D. distincta, D. strangulata, *Id.* Ib., pl. 2, figs. 3—6.

— catenula, D. discrepans, D. filiformis, D. pugiunculus, *Id.* Ib., pl. 3, figs. 6—9.

Nodosaria dentalina, *Parker* and *Jones*. Ann. Nat. Hist., ser. 3, vol. vi, p. 39.

Dentalina pauperata, *Id.* Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. 19, fig. 22.

— nuda, *Reuss*, 1862. Sitzungs. Akad. Wiss., vol. xlvi, p. 38, pl. 2, figs. 8, 9.

— pseudochrysalis, *Id.* Ib., p. 40, pl. 2, fig. 12.

— Hilseana, *Id.* Ib., p. 41, pl. 2, fig. 14.

— linearis, *Id.* Ib., p. 42, pl. 2, fig. 15.

— cylindroides, *Id.* Ib., fig. 16.

— lamilifera, *Id.* Ib., fig. 17.

— Benningseni, D. indifferens, *Reuss*, 1863. Sitzungsb. Akad. Wien., vol. xlviii, 1 Abth., p. 44, pl. 2, figs. 14—16.

— consobrina, *Id.* Ib., figs. 19—23.

— acuticauda, *Id.* Ib., p. 45, pl. 3, fig. 26.

— bucculenta, D. detornata, *Schwager*, 1864. In Dittmar's Die Contorta-zone, pp. 404, 406, pl. 3, figs. 8, 9.

— collisa, *Id.* Ib., p. 405, pl. 3, fig. 10.

Marginulina incerta, *Id.* Ib., p. 407, pl. 3, fig. 13.

Dentalina æqualis, *Karrer*, 1864. Novara-Exped., Geol. Theil, vol. i, part 2, p. 74, pl. 16, fig. 1.

Nodosaria (Dentalina) pauperata, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 342, pl. 13, figs. 8, 9.

— — consobrina, *Id.* Ib., pl. 16, fig. 3.

Dentalina vagina, *Stache*, 1865. Novara-Exped., Geol. Theil, vol. i, part 2, p. 206, pl. 22, fig. 34.

Nodosaria inarticulata, N. tenuicollis, *Reuss*, 1865. Sitzungs. Akad. Wien., vol. lii, 1 Abtheil., p. 7, pl. 1, figs. 5, 6.

— (Dentalina) grandis, *Reuss*, 1866. Deutsch. Acad. Wien., vol. xxv, p. 15, pl. 1, figs. 26—28.

— — pygmæa (*Neueg.*), *Id.* Ib., p. 17, pl. 2, fig. 9.

— — abnormis, *Id.* Ib., p. 18, pl. 4, fig. 10.

— — acuticauda, *Id.* Ib., p. 17, pl. 2, fig. 11.

— — consobrina, var. emaciata, *Id.* Ib., p. 16, pl. 2, figs. 12, 13.

— — vermiculum, *Id.* Ib., p. 17, pl. 2, figs. 14, 15.

— — approximata, *Id.* Ib., p. 18, pl. 2, fig. 22.

β. *With oblique septa.*

NODOSARIA (DENTALINA) COMMUNIS, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 254, No. 35; 1840, Mém. Soc. Géol. France, vol. iv, p. 13, pl. 1, fig. 4.

— — OBLIQUA, *Id.* Ib., No. 36; Modèle No. 5.

— — ARCUATA, *Id.* Ib., No. 38.

— — CARINATA, *Id.* Ib., p. 255, No. 39.

DENTALINA CINGULATA, *Czjzek*, 1848. Haidinger's Naturwiss. Abhandl., vol. ii, pl. 12, figs. 8, 9.

— FERSTLIANA, *Id.* Ib., figs. 10—13.

— ACUS, *Reuss*, 1851. Haid. Nat. Abhandl., vol. iv, pl. 2, fig. 15.

MARGINULINA ENSIS, M. ELONGATA, M. APICULATA,[1] *Id.* Ib., figs. 16—18.

NODOSARIA COMMUNIS, *Reuss*, 1845. Verst. Böhm. Kreid., part 1, p. 28, pl. 12, fig. 21.

— (et VAGINULINA) LEGUMEN, *Id.* Ib., p. 64, pl. 13, figs. 23, 24.

VAGINULINA BADENENSIS, *D'Orb.*, 1846. For. Foss. Vien., p. 65, pl. 3, figs. 6—8.

DENTALINA GLOBULIGERA, *Neuegeboren*, 1856. Denks. Akad. Wiss., vol. xii, p. 81, pl. 2, fig. 10.

— CONFERTA, *Id.* Ib., fig. 11.

— HAUERI, *Id.* Ib., fig. 12.

— ROEMERI, *Id.* Ib., p. 82, pl. 2, figs. 13—17.

— ORBIGNYANA, *Id.* Ib., pl. 3, figs. 1—3.

— SUBTILIS, *Id.* Ib., p. 83, pl. 3, fig. 4.

— PARTSCHII, *Id.* Ib., fig. 5.

— MUCRONATA, *Id.* Ib., p. 85, pl. 3, figs. 8—11.

— SUBULATA, *Id.* Ib., fig. 13.

NODOSARIA (DENTALINA) COMMUNIS, var., *Parker* and *Jones*. Ann. Nat. Hist., 2nd ser., 1864, vol. xix, p. 282, pl. 11, fig. 1; 1865, Phil. Trans., vol. clv, p. 342, pl. 13, fig. 10.

DENTALINA VETUSTA, *Terquem*, 1858. Mém. Acad. Metz, 39 année, p. 598, pl. 2, fig. 4.

— TORTA, *Id.* Ib., p. 599, pl. 2, fig. 6.

— SUBARCUATA, *Williamson*, 1858. Rec. Fos. Gr. Brit., p. 18, pl. 2, figs. 40, 41.

— COMMUNIS, *Eley*, 1859. Geology in the Garden, p. 199, pl. 4, fig. 21, and pl. 6, fig. 33.

— BREVIS, *Parker* and *Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. 19, figs. 23, 24.

— COMMUNIS, *Id.* Ib., figs. 25, 26.

VAGINULINA LEGUMEN,[2] *Id.* Ib., figs. 27, 28.

DENTALINA INTERMEDIA, *Reuss*, 1860. Sitz. Akad. Wien., vol. xl, p. 42, pl. 8, fig. 8.

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[1] These are quoted to show the extremely slight difference between Dentaline and Marguline *Nodosarinæ.*

[2] Quoted to show how inseparable all these forms really are.

DENTALINA LEGUMEN, *Reuss*, 1860. Sitz. Akad. Wien., vol. xl, p. 43, pl. 9, fig. 5.
— COLLIGATA, *Reuss*, 1861. Sitzungs. Ak. Wien., vol. xliv, 1 Abth., p. 334, pl. 7, fig. 4.
— NANA, *Reuss*, 1862. Ib., vol. xlvi, p. 39, pl. 2, figs. 10, 18.
— SILIQUA, *Id.* Ib., p. 40, pl. 2, fig. 11.
— DEFLEXA, *Id.* Ib., p. 43, pl. 2, fig. 19.
— BOETTCHERI, *Reuss*, 1863. Ib., vol. xlviii, 1 Abtheil., p. 44, pl. 2, fig. 17.
— INORNATA, *Id.* Ib., p. 45, pl. 2, fig. 18.
— ABNORMIS, D. OBLIQUATA, *Id.* Ib., p. 46, pl. 2, figs. 24, 25.
— MARGINATA, D. OBLIQUESUTURATA, *Stache*, 1865. Novara-Exped., Geol. Theil, vol. i, part 2, p. 207, pl. 22, figs. 35, 36.
MARGINULINA DURACINA, *Id.* Ib., p. 211, pl. 22, fig. 42.

Characters.—Shell elongated, tapering, more or less curved; consisting of numerous segments, generally somewhat ventricose. Primordial segment sometimes larger than the second, and either rounded or pointed at its free extremity. The terminal pseudopodial aperture more or less excentric, sometimes pouting on a prolonged neck, but more commonly a simple orifice, surrounded by radiating grooves. Septal lines often more or less oblique, and generally constricted. Length $\frac{1}{20}$th to $\frac{1}{6}$th inch.

Although it may be thought that the list of synonyms we have quoted has been carried to an excessive length, we may be allowed to state that it is by no means an exhaustive catalogue. We have carefully avoided doubtful figures; and in our references to the papers of foreign authors, whenever there has seemed to be anything like a sufficiently distinct character on which to found a sub-variety, we have omitted the name from our table. It is only this desire to be on the safe side in massing previously described "species," that has prompted us to admit such sub-varietal forms as *D. pauperata* and *D. brevis* to separate mention.

Dentalina communis is an extremely common variety wherever Nodosarian forms occur in the clays of the Secondary formations, but usually it is of small size. It is larger in the Gault than in the Jurassic clays; still larger in the Chalk-marl and Chalk; and in the Maestricht Chalk it is large, as well as in the Tertiary beds that yield *Nodosarinæ*, being very finely developed in the Sub-Apennine clays. Older than the Secondary deposits, however, it is found in the Permian limestones of England and Germany.

The Crag specimens in Mr. Searles Wood's collection from Sutton are numerous, exceedingly large, and correspond to *D. pauperata* and such like modifications of group *a*.

The Bridlington Crag has supplied a specimen corresponding to D'Orbigny's *D. brevis*, of the same group *a*.

D. communis is a common recent species; indeed, its geographical range is as extraordinary as the extent of its geological distribution. It is found in every latitude from

the Arctic circle to the equator. It occurs in many sandy shore-deposits; but its favorite habitat is mud at 50—100 fathoms, and is continually met with in the deepest soundings, although never abundant there, and generally small.

Dentalina communis, *D'Orbigny.*

Sub-variety—D. pauperata, *D'Orb.* (see above, p. 59).

Characters.—Shell elongate, sub-cylindrical, composed of many chambers. The early chambers sometimes cylindrical, the others more or less ventricose. Shell often irregular and unsymmetrical. Length $\frac{1}{12}$th to $\frac{1}{8}$th inch.

Dentalina pauperata is a mere name of convenience for certain forms of *Dentalina communis,* in which the chambers have a compact style of growth, the septal lines being sometimes quite obscured. Large specimens were not uncommon in the Crag beds at Sutton worked by Mr. S. Wood.

We find *D. pauperata* in marls of the Lias, in the Chalk, in the various fossiliferous Tertiary clays, and occasionally recent where other *Dentalinæ* abound.

Dentalina communis, *D'Orbigny.*

Sub-variety—D. brevis, *D'Orb.* (see above, p. 59).

Characters.—Shell stout, sub-cylindrical, consisting of few (three to five) rather ventricose and more or less compact chambers. Length $\frac{1}{10}$th inch.

Of the poorly grown specimens of unstriated *Dentalinæ* (or curved *Nodosaria radicula*), the stunted few-chambered forms may be conveniently taken together under D'Orbigny's designation *D. brevis.* The characters are of little interest or significance, and it is so associated in distribution with the sub-typical *D. communis* as not to require separate treatment. Our figured specimen is from the Bridlington Crag.

Subgenus—Vaginulina, *D'Orbigny.*

Orthoceras, *Gualtier, Batsch, Hanley.*
Nautilus, *Linné, Martini, Schroeter, Gmelin, Montagu, Turton, Maton* and *Rackett, Dillwyn, W. Wood.*

ORTHOCERA, *Lamarck, Blainville, Fleming, Thorpe.*
VAGINULINA, *D'Orbigny, Roemer, Ehrenberg, Macgillivray, Bronn, Morris, Reuss, Parker* and *Jones, Terquem, Bornemann, Neuegeboren, Cornuel, Karrer, Brady, Seguenza,* &c.
DENTALINA (in part), *Macgillivray, Williamson.*
SPIRALINA, *Brown.*

Characters.—Shell elongate, tapering, straight or arcuate, compressed; composed of several oblique segments, arranged in a linear series; slightly or not at all constricted at the septal lines. Aperture marginal.

Vaginulina proper has a compressed shell, but some specimens have the earlier segments compressed and the later chambers vesicular, thus comprising Dentaline or Marginuline characters, as the case may be. In a Nodosarian shell with oblique chambers, if there be no compression, the shell is a *Marginulina* if stout, and a *Dentalina* if tapering. If commencing with an inclination to be spiral, the shell is a *Marginulina* if stout, but a *Planularia* if much compressed, in either case pointing towards *Cristellaria.*

Vaginulinæ may have any of the ornaments found in other *Nodosarinæ,* but they usually take on, in various degrees, and either alone or combined, first, a limbation of the septal lines and of the margins, and secondly, riblets, continuous or interrupted, and usually oblique to the axis of the shell.

Vaginulina legumen, Linné, is the type of these elongate, compressed, and oblique-chambered *Nodosarinæ.* The form referred to by Linné is smooth and compact in growth, and has limbate or thickened septal lines; *Vag. elegans,* D'Orb., and *V. ligata,* Rss., are still more limbate; Batsch figures a much less compact shell, without ornament, as *Nautilus leguminiformis;* keeled individuals (limbate on the margins only) are D'Orbigny's *Vaginulina marginata* and *V. caudata;* ribbed, without limbation, *V. linearis,* Montagu, sp., being either very sparingly ornamented or ribbed all over; partly ribbed and limbate, *V. margaritifera,* Batsch; much compressed and ribbed, *V. striata,* D'Orb.—and so on.

Genus—VAGINULINA LEGUMEN, *Linné,* sp.

a. Chambers distinct, not compact, unornamented.

NAUTILUS (ORTHOCERAS) LEGUMINIFORMIS, *Batsch,* 1791. Conch. Seesand., pl. 3, fig. 8 *a.*
NODOSARIA LEGUMEN, *Reuss,* 1845. Verst. Böhm. Kreid., part 1, p. 28, pl. 13, figs. 23, 24.
DENTALINA COMMUNIS (parte), *Parker* and *Jones,* 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. 19, fig. 26.

β. Chambers compactly set on, without ornament.

Nautilus rectus geniculis depressis, *Walker* and *Jacob*, 1784. Test. Minut., p. 21, pl. 1, fig. 74.
Vaginulina lævigata, *Roemer*, 1838. Neues Jahr. f. 1838, p. 383, pl. 3, fig. 11.
— elongata, *Id.*, 1840. Verst. Nordd. Kreid., p. 96, pl. 15, fig. 13.
— Badenensis, *D'Orb.*, 1846. For. Foss. Vien., p. 65, pl. 3, figs. 6—8.
— lævigata (*Roem.*), *Reuss*, 1848. Sitz. Ak. Wiss., vol. xviii, p. 226, pl. 1, fig. 9.
Dentalina legumen, *Williamson*, 1858. Monog. Rec. Foram., p. 21, pl. 2, figs. 45—49.
Vaginulina legumen, *Parker* and *Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. 19, figs. 27, 28.

γ. Compact; limbate.

Orthoceras minutum, &c., *Gualtier*, 1742. Index Test., pl. 19, figs. p, q.
Nautilus legumen, *Linn.*, 1758. Syst. Nat., edit. x, p. 711, No. 248; 1767, ed. xii, p. 1164, No. 288.
— — *Montagu*, 1808. Test. Brit. Suppl., p. 82, pl. 19, fig. 6.
Vaginulina — *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 257, No. 2.
— elegans, *Id.*, 1826. Ib., No. 1.
— ligata, *Reuss*, 1864. Sitz. Akad. Wiss. Math.-Nat. Cl., vol. l, Abth. 1, p. 23, pl. 1, fig. 11.
— recta, *Karrer*, 1864. Novara-Exped., Abtheil. Palæont., p. 74, pl. 16, fig. 2.

δ. Compact; limbate on the margins only.

Vaginulina marginata, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 258, No. 7.
— caudata, *Id.* Ib., No. 8.

ε. Compact; limbate and ribbed.

Nautilus (Orthoceras) margaritiferus, *Batsch*, 1791. Conch. Seesand., pl. 4, figs. 12 *a*—12 *c*.

ζ. Compact; narrow or subcylindrical; costulate.

NAUTILUS LINEARIS, *Montagu*, 1808. Test. Brit. Suppl., p. 87, pl. 30, fig. 9.
DENTALINA LEGUMEN, var. LINEARIS, *Williamson*, 1858. Monog. Rec. For., p. 21, pl. 2, figs. 46, 47.
VAGINULINA LINEARIS, *Parker* and *Jones*, 1865. Phil. Trans., vol. clv, p. 343, pl. 13, figs. 12, 13.
NODOSARIA (VAGINULINA?) [fragment], *Parker* and *Jones*, 1857. Ann. Nat. Hist., 2nd ser., vol. xix, p. 282, pl. 11, fig. 2.

η. Compact; much compressed; smooth.

PLANULARIA LONGA, *Cornuel*, 1848. Mém. Soc. Géol. Fr., 2nd ser., vol. iii, p. 253, pl. 1, figs. 38, 39.

θ. Compact; much compressed; ribbed.

VAGINULINA STRIATA, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 257, No. 3.

ι. Compact; much compressed; limbate.

VAGINULINA KOCHII, *Roemer*, 1840. Verst. Nordd. Kreid., p. 96, pl. 15, fig. 10.

κ. Compact; much compressed; limbate and ribbed.

VAGINULINA STRIGILLATA, *Reuss*, 1845. Verst. Böhm. Kreid., part 2, p. 106, pl. 24, fig. 29.

η, θ, ι, κ, constitute the group "*Citharina*," instituted by D'Orbigny (Modèle No. 115, Livr. 5; and 'Foram. Cuba,' p. xxxvii), but subsequently disused by him.

VAGINULINA LÆVIGATA, *Roemer*. Plate IV, fig. 9.

(For synonyms, see above, p. 65.)

Characters.—Shell straight or curved, more or less compressed; chambers set on compactly, smooth. Length $\frac{1}{5}$th inch.

We do not find a published figure exactly like our specimen from the Crag of Bridlington; but we cannot allow ourselves to give it a new name merely because it is rather stouter than the common smooth *Vaginulinæ*. Were it not quite so compressed and so

acutely oval in cross section, we might regard it as a *Marginulina*, such as *M. Webbiana*, D'Orb.,[1] and *M. obliqua*, Reuss;[2] and, indeed, it has almost as much right to be in that group of the *Nodosarinæ* as among the *Vaginulinæ*.

VAGINULINA LINEARIS, *Montagu*. Pl. I, figs. 10—12.

(For synonyms, see above, p. 66.)

Characters.—Shell straight or bent, more or less compressed; chambers compactly set on, more or less oval in section; ornamented in a variable degree with delicate parallel riblets, mostly oblique to axis of the shell; aperture excentric. Length $\frac{1}{5}$th inch.

Whether in the fine specimens from the Crag of Sutton (collected by Mr. S. V. Wood) we have large *Dentalinæ obliquestriatæ*, imperfectly ornamented, or *Vaginulinæ lineares*, more Nodosarian in their make than usual, it is difficult to say. We adopt the latter supposition. In many instances *Vaginulina linearis* loses its compressed shape, and takes on more inflated chambers in its further growth, becoming Dentaline; and such seems to have been the habit of the Sutton specimens. After all, it is clear that neither *D. obliquestriata* nor *V. linearis* are real species, and can be separately referred to only for convenience.

As *Marginulina Webbiana*, D'Orb., and *M. obliqua*, Reuss, are almost indistinguishable from *Vaginulina lævigata*, so *M. vaginella* and *M. semicostata*, Reuss,[3] are Marginuline conditions of *V. linearis;* and *V. recta*, Karrer,[4] may be said to be the Marginuline form of *V. legumen* proper.

The elegant Foraminifer illustrated by pl. 5, fig. 2, 'Sitzung. Akad. Wiss., Math.-Nat. Cl.,' vol. l, part i, 1864, and described at p. 26, *op. cit.*, by Professor Reuss, as a variety of *Flabellina ensiformis*, Münst. and Roem., represents the fully costate condition of *Vaginulina legumen*, the common specimens of var. *linearis* being only partially covered with riblets. How this *Vaginulina* passes into *Flabellina* may be seen by Reuss's figs. 23 and 24, pl. 2, 'Sitzung. Akad. Wiss.,' vol. xviii, 1855; whilst *Cristellaria gladius*, Phil., fig. 31, of the same plate, shows *Vaginulina legumen* becoming a *Cristellaria*. In fact, links between all the *Nodosarinæ* may readily be found.

As for *V. linearis*, this form of *Vaginulina* only differs from the sub-typical *V. legumen* in costation of the surface of the shell, a character of extreme variability. Many specimens only show these markings on the first two or three chambers, whilst in others they are apparent over the greater portion, and in some cases over the whole length of the

[1] 'Foram. Canaries,' 1839, p. 124, No. 4, figs. 7—11; and 'Foram. Amér. Mérid.,' p. 24, pl. 5, figs. 17, 18.

[2] 'Denks. Akad. Wien.,' vol. vii, 1854, p. 69, pl. 25, fig. 9.

[3] 'Zeitsch. Deutsch. Geol. Gesell.,' vol. iii, 1851, p. 152, pl. 8, figs. 2, 3.

[4] 'Novara-Exped.,' Abth. "Palæont.," p. 74, pl. 16, fig. 2.

shell. We have never seen it so abundant as in some sands dredged in from thirty to forty fathoms, in Berwick Bay, and in that locality the finely grown *Vaginulinæ* were found to be almost without exception in the ribbed condition. It is impossible to distinguish the smooth, slender, depauperated forms of *Vaginulina* from *Dentalina communis*; indeed, the two varieties merge insensibly into each other, whilst the costulate *Vaginulinæ* are barely separable from *D. obliquestriata*.

V. linearis is not uncommon in a recent condition on our own shores, though it appears to be somewhat local in its distribution, and the same remark applies to its occurrence in seas of both colder and warmer latitudes.

In a fossil state it is less common, but it is occasionally met with in beds belonging to the Secondary and Tertiary periods.

Subgenus—Marginulina, *D'Orbigny*.

Nautilus, Orthoceras, Orthocera, Cristellaria, Orthocerina, Hemicristellaria, *Auctorum.*
Marginulina, *D'Orbigny, Cornuel, Roemer, Reuss, Neuegeboren, Bornemann, Parker, Jones, Brady, Terquem, Karrer, Costa, &c.*

Characters.—Shell elongated, subcylindrical or flattened, straight or arcuate, tending to spiral mode of growth in the earlier chambers; ornamented with ribs, granules, spines, &c., as other *Nodosarinæ*. Aperture nearly always excentric towards or close to the convex margin of the shell.

The difficulty of defining any special groups among the Marginuline *Nodosarinæ* is insuperable, every character being variable, namely, the excentricity of the axis of the shell (whether amounting to spirality or simply to a curvature), the compression, and the ornamentation, which last has the same patterns as in other *Nodosarinæ*.

We may take the simple smooth *Marginulinæ* as one group; but we are baffled by the ever-varying proportions and shape among them; and, hesitating to adopt a name for every individual, we are obliged to take *M. glabra* (see further on) as a subtype, though it graduates in form into *Vaginulina, Dentalina,* and *Nodosaria,* on one hand, and into *Cristellaria* on the other; whilst, as to ornament, it takes on more or less of the exogenous shell-growth, thus becoming any one of the hispid, costate, limbate, or otherwise ornamented varieties.

For another subtype in our artificial grouping, we may take the ribbed *M. raphanus,* to be presently described. For another, the keeled forms *M. carinata,* D'Orb.,[1] and *M. angistoma,* Stache,[2] may serve. A fourth group may comprise the limbate varieties, either

[1] 'Ann. Sc. Nat.,' vol. vii, p. 259, No. 8. [2] 'Novara-Exped.,' &c., pl. 22, fig. 46.

simply limbate, as *M. obliqua* and *Cristellaria Gosæ*, Reuss,[1] or granulato-limbate, as *Marginulina Wetherellii*, Jones,[2] and *Cristellaria decorata*, Reuss.[3] A fifth series contains those which have the chamber-walls swollen or thickened by bars transverse to the axis of the shell (*M. trilobata*, D'Orb.[4]), or knobbly, as *Marginulina Hochstetteri*, Stache,[5] and *Hemicristellaria papillata*, Stache.[6] In others the growth of coarse granules is carried to so great an extent that they encroach on each other, leaving only irregularly reticulate fissures, or sunken lines, on the exterior, as Stache's *Hemicristellaria verrucosa*.[7] Lastly, a group may be formed of the prickly *Marginulinæ*, with *M. hirsuta*, D'Orb.,[8] as a centre. But all these graduate one into the other, as respects both form and ornamentation.

MARGINULINA GLABRA, *D'Orbigny*. Plate I, fig. 36.

MARGINULINA GLABRA, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 259, No. 6; Modèle No. 55.
— LÆVIGATA, *Id.* Ib., No. 10.
— LITUUS, *Id.* Ib., No. 11; *Soldani*, Testac., vol. ii, p. 99, pl. 106, figs. *aa*, *bb*.
— WEBBIANA, *D'Orb.*, 1839. For. Canaries, p. 124, pl. 1 figs. 7—11; For. Amér. Mérid., p. 24, pl. 5, figs. 17, 18.
CRISTELLARIA BERTHELOTIANA, *Id.* Ib., p. 125, pl. 1, figs. 14, 15.
MARGINULINA COMPRESSA, *D'Orb.*, 1840. Mém. Soc. Géol. Fr., vol. iv, p. 17, pl. 1, figs. 18, 19.
— ELONGATA, *Id.* Ib., figs. 20—22.
— COMMA, *Roemer*, 1840. Verst. Nordd. Kreid., p. 96, pl. 15, fig. 15.
— ELEGANS, *S. Wood*, 1843. In Morris's Cat. Brit. Foss., p. 62.
— REGULARIS, *D'Orb.*, 1846. For. Foss. Vien., p. 68, pl. 3, figs. 9—12.
— PEDUM, *Id.* Ib., figs. 13, 14.
— SIMILIS, *Id.* Ib., p. 69, pl. 3, figs. 15, 16.
CRISTELLARIA HAUERINA, *Id.* Ib., p. 84, pl. 3, figs. 24, 25.
— RHOMBOIDEA, *Czjzek*, 1848. Haid. Abhandl., vol. ii, pl. 12, figs. 21—23.
— LISTI, *Bornemann*, 1854. Lias Formation, p. 40, pl. 4, fig. 28.
MARGINULINA BACHEI, *Bailey*, 1857. Smith's Contrib., vol. ii, 1861, art. iii, pl. 1, figs. 2—6.

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[1] 'Denks. Akad. Wien.,' vol. vii (1854), pl. 25, figs. 9, 10.
[2] In Morris's 'Catal. Brit. Foss.,' 2nd ed., 1854, p. 37.
[3] 'Zeits. Deut. Geol. Ges.,' vol. vii, 1855, pl. 8, fig. 16, and pl. 9, figs. 1, 2.
[4] Mém. Soc. Géol. Fr.,' vol. iv, pl. 1, fig. 16.
[5] Op. cit., pl. 22, fig. 55.
[6] Op. cit., pl. 23, fig. 4.
[7] Op. cit., pl. 23, fig. 5. An analogous ornamentation characterises Stache's *Cristellaria bufo* (op. cit., pl. 23, fig. 18), *Lingulina rimosa* (pl. 22, fig. 16), and *Glandulina rimosa* (pl. 22, fig. 10).
[8] 'Ann. Sc. Nat.,' vol. vii, p. 259, No. 5; 'For. Foss. Vien.,' p. 69, pl. 3, figs. 17, 18.

Cristellaria subarcuatula, var. elongata, *Williamson*, 1858. Rec. For., Gt. Br., p. 30, pl. 2, fig. 62.
Marginulina sublituus, *Parker* and *Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. 20, fig. 37.
— lituus, *Id.*, 1862. App. Carpenter's Introd., p. 310; 1865, Phil. Trans., vol. clv, p. 343, pl. 13, figs. 14^a, 14^b.

Characters.—Shell lituate or oblong, sometimes flattened, composed of several more or less oblique segments, the earlier chambers arranged on a spiral or nautiloid plan; the later chambers usually wider, and always in a linear series. Chambers often ventricose, and the septal lines correspondingly constricted. Margin of the shell thin, but rarely carinate. Length $\frac{1}{25}$th inch or more.

Marginulina glabra, with its feeble, elongated, smooth, partially coiled shell, is one of the intermediate links of *Nodosarina*. Indeed, a well-coiled bold specimen of this variety would have nothing to distinguish it from *Cristellaria rotulata*.

In distribution geologically, it accompanies its natural allies, commencing in the Upper Trias and reappearing in most of the fossiliferous deposits up to the later Tertiaries.

We have seen recent specimens from the west coast of Scotland (shallow water), from the Norwegian coast, the Red Sea (557 fathoms), and from the South Atlantic (260 fathoms); besides which it occurs off the coast of New Jersey, in the Mediterranean, and doubtless in many other localities.

One or two very small examples in Mr. S. Wood's collection from Sutton constitute the only evidence we have of its presence in the Crag deposits.

Marginulina raphanus, *Linné*. Plate I, fig. 21.

Nautilus raphanus, *Linné*, 1758. Syst. Nat., edit. x, p. 711, No. 243; edit. xii, 1767, p. 1164, No. 283.
— granum, *Id.* Ib., No. 244, edit. xii, 1767, p. 1164, No. 284.
— (Orthoceras) costatus, *Batsch*, 1791. Sechs Kupfertafeln, pl. 1, figs. 1 *a* — 1 *g*.
Marginulina raphanus, *D'Orb.*, 1826. Ann. Sc. Nat., vol. vii, p. 258, No. 1, pl. 10, figs. 7, 8; Modèle No. 6.
— sublituus, *Id.*, 1826. Ann. Sc. Nat., vol. vii, p. 259, No. 9.
— raphanus, *Ehrenberg*, 1839. Transact. Berlin Akad. for 1838, p. 59, pl. 1, figs. 2 a, b.
Orthocerina multicostata, *Bornemann*, 1854. Liasformation, p. 35, pl. 2, fig. 14.
Cristellaria subarcuatula, var. costata, *Williamson*, 1858. Rec. For. Gr. Br., p. 31, pl. 2, fig. 63.

Vaginulina sulcata, *Costa* (n. d.). For. Foss. Terz. Messina, p. 18, pl. 2, figs. 17 a, b.
Marginulina raphanus, *Parker* and *Jones*, 1862. In App. Carpenter's Introd., p. 310.
— interrupta, *Stache*, 1865. Novara-Exped., Geol. Theil, vol. i, part 2, p. 212, pl. 22, fig. 45.
— apiculata [apiculifera on the plate], *Id.* Ib., p. 216, pl. 22, fig. 49.
— spinulosa, *Id.* Ib., fig. 51.
— tricuspis, *Id.* Ib., p. 218, fig. 52.
— asprocostulata, *Id.* Ib., p. 219, fig. 53.
— elatissima, *Id.* Ib., fig. 54.[1]

Characters.—Shell elongated, subcylindrical or somewhat flattened, arcuate or straight; composed of few chambers, often ventricose, and the earlier ones often showing tendency towards a spiral mode of growth. Surface ornamented with stout ribs running from end to end of the shell. Length $\frac{1}{36}$th inch and more.

The Marginuline form of Linné's *Nautilus raphanus* is so intimately associated with its Nodosarian form that D'Orbigny was quite correct in cataloguing them together under the name of *Marginulina raphanus;* but he made a distinction without a difference in separating the more elongate form, as *Nodosaria rapa.*

The figures in Soldani's 'Testaceographia,' to which D'Orbigny refers as illustrations of *Marginulina raphanus,* are associated on the same plate with several *Nodosariæ,* such as *N. rapa*, D'Orb. (=*N. raphanus*) and *N. scalaris,* among which the gradational conditions may be plainly seen.

The robust proportions and characteristic Nodosarian ornamentation of *Marginulina raphanus,* together with the facts that the eccentricity of its aperture is variable, and that whilst it has not the helicoid arrangement of the earlier chambers, but is rather allied to the straight varieties, it shows by its curvature the tendency to a spiral mode of growth, render it the most eligible type for the whole series of *Nodosarinæ.* In addition to its suitability on morphological grounds, it has claims for acceptance on the score of priority, as it was one of the very few Foraminifera described and named by Linné, and consequently one of the first of which we have scientific record.

Marginulina raphanus is often found among the specimens of *Nodosaria raphanus* abounding at Rimini, in the Adriatic; but otherwise it is by no means a common Foraminifer,

[1] Of these, figs. 49, 51, and 54 represent individuals in which the ribbing is weak; and, indeed, in fig. 45 the ribs fail on the last chamber. Still further, some specimens are figured as *M. angistoma* (fig. 46), *M. opaca* (fig. 47), and *M. mucronulata* (fig. 48), on the same plate, which show an absence of costation (excepting a keel in fig. 46), and more or less irregularity of growth, thus presenting the Marginuline condition of Stache's *Nodosaria erecta* (fig. 12=*N. radicula*), just as the above-quoted costate forms and Stache's *N. striatissima* together are Nodosarian and Marginuline conditions of *Nodosarina raphanus.*

either in a recent or fossil state. We have it from various Liassic marls, and it occurs in many Tertiary deposits in company with other commoner varieties of the same type. In a living condition it is very sparingly distributed.

Mr. S. Wood found it in the Crag of Sutton, but the specimens were few and small.

Subgenus—Cristellaria, *Lamarck*.

Nautilus, *Linné, Gmelin, Walker* and *Jacob, Montagu, Maton* and *Rackett, Pennant, Fichtel* and *Moll, Sowerby, Turton, Fleming, Brown*, &c.
Lenticulites, *Lamarck, Defrance, Nilsson, Hisinger.*
Lenticulina, *Lamarck, Defrance, Parkinson*, &c.
Polystomella, *Lamarck.*
Nummularia (in part), *Sowerby.*
Cristellaria, *Lamarck, Defrance, D'Orbigny, Ehrenberg, Czjzek, Reuss, Münster* and *Roemer, Cornuel, Philippi, Hagenow, Bronn, Morris, Parker* and *Jones, Williamson, Bornemann, Terquem, Carpenter, Costa, Seguenza, Brady, Karrer*, &c.
Nummulina (in part), *D'Orbigny.*
Phonemus, Pharamum, Antenor, Robulus, Patrocles, Sphincterulus, Clisiphontes, Herion, Rhinocurus, Macrodites, Lampas, Scortimus, Astacolus, Periples, *Montfort.*
Oreas, *Montfort, Blainville.*
Linthuris, *Montfort, Blainville.*
Saracenaria, *Defrance, D'Orbigny.*
Robulina, *D'Orbigny, Münster* and *Roemer, Ehrenberg, Czjzek, Reuss, Bronn, Morris, Bornemann, Terquem, Costa, Karrer, Stache*, &c.
Hemicristellaria, Hemirobulina, *Stache.*

Characters.—Shell round, oval, or oblong, disco-spiral, lenticular, or compressed, bilaterally symmetrical as regards the longer axis, as is the case with the other *Nodosarinæ*; formed of a spiral set of chambers, in one or more whorls; chambers either curved or triangular, or both, and variable in size and shape, compactly set, increasing successively in size, slowly or rapidly, and more or less embracing the earlier part of the spire. Aperture excentric, either slit-like, triangular, or round, radiated, usually close to the outer or convex margin, but sometimes pouting and nearer the middle of the septal plane. Surface either smooth or ornamented with any or all of the following features—limbation of the septal lines, ribs, bars, or granules, umbonal knobs, marginal keel and spikes.

The lenticular *Cristellaria* without any keel is *C. rotulata*, Lamarck; with a keel, *C. cultrata*, Montfort; with a broad keel, commonly toothed, it becomes *C. calcar*, Linné. When much compressed and broadly keeled, it is *C. cassis*, F. and M. Some lenticular

APPENDIX I.

CLASSIFIED TABLE OF THE FORAMINIFERA OF THE CRAG.

SUB-KINGDOM—PROTOZOA.

Class—RHIZOPODA.

Order—RETICULARIA (FORAMINIFERA).

SUB-ORDER—*IMPERFORATA*.

FAMILY—MILIOLIDA.

Type.—CORNUSPIRA FOLIACEA, *Phil.*	1.	Cornuspira foliacea, Philippi	PLATE III	Figs. 50, 51.
	2.	— involvens, Reuss	" III,	" 52—54.
Type.—MILIOLA SEMINULUM, *Linn.*	3.	Biloculina ringens, Lamk.	" III,	" 26—28.
	4.	— elongata, D'O. (not figured).		
	5.	— depressa, D'O.	" III,	" 29, 30.
	6.	Triloculina tricarinata, D'O.	" III,	" 33, 34.
	7.	— oblonga, Montagu	" III,	" 31, 32.
	8.	Quinqueloculina triangularis, D'O.	" IV,	" 1.
	9.	— seminulum, Linn.	" III,	" 35, 36.
	10.	— subrotunda, Mont. (not figured).		
	11.	— tenuis, Cz. (not figured).		
	12.	— Ferussacii, D'O.	" IV,	" 4.
	13.	— pulchella, D'O.	" IV,	" 3.
	14.	— Brongniartii, D'O.	" III, " IV,	" 41, 42. " 2.
	15.	Spiroloculina planulata, Lamk.	" III,	" 37, 38.
	16.	— canaliculata, D'O.	" III,	" 39, 40.
Type.—PENEROPLIS PERTUSUS, *Forsk.*	17.	Dendritina arbuscula, D'O.	" III,	" 48, 49.
	18.	— Spirolina cylindracea, Lam. (not fig.).		
Type.—ORBICULINA ADUNCA, *F. & M.*	19.	Orbiculina adunca, F. & M.	" III,	" 44.
	20.	— compressa, D'O.	" III,	" 43.
Type.—ORBITOLITES ORBICULUS, *Forsk.*	21.	Orbitolites orbiculus, Forsk.	" III,	" 45—47.
Type.—ALVEOLINA MELO, *F. & M.*	22.	Alveolina, sp. (not figured).		

FAMILY—LITUOLIDA.

Type.—TROCHAMMINA SQUAMATA, *P. & J.*	23.	Webbina hemisphærica, P. J. & B.	PLATE IV,	Fig. 5.

SUB-ORDER—*PERFORATA*.

FAMILY—LAGENIDA.

Type.—LAGENA SULCATA, *W. & J.*	24.	Lagena striata, D'O.	PLATE	I,	Figs. 38, 39.
	25.	— sulcata, W. & J.	,,	I,	,, 40—43.
	26.	— lævis, Montagu	,,	I,	,, 28.
	27.	— apiculata, Rss.	,,	I,	,, 27.
	28.	— semistriata, D'O.	,,	IV,	,, 6.
	29.	— gracillima, Seg.	,,	I,	,, 36, 37.
	30.	— marginata, Montagu	,,	I,	,, 33, 34.
	31.	— ornata, Will.	,,	I,	,, 29, 30, 31.
	32.	— squamosa, Montagu	,,	IV,	,, 7.
	33.	— melo, D'O.	,,	I,	,, 35.
	34.	— globosa, Montagu	,,	I,	,, 32.
Type.—NODOSARINA RAPHANUS, *Linn.*	35.	Glandulina lævigata, D'O.	,,	I,	,, 1—3.
	36.	Nodosaria raphanus, Linn.	,,	I,	,, 4 & 5, 22 & 23.
	37.	— raphanistrum, Linn.	,,	I,	,, 6—8, 44 & 45.
	38.	— scalaris, Batsch.	,,	IV,	,, 8.
	39.	Dentalina pauperata, D'O.	,,	I,	,, 13—18, 20.
	40.	— obliquestriata, Reuss.	,,	I,	,, 19.
	41.	— brevis, D'O.	,,	IV,	,, 10.
	42.	— obliqua, Linn.	,,	I,	,, 9.
	43.	Vaginulina linearis, Montagu	,,	I,	,, 10, 11.
	44.	— lævigata, Roemer	,,	IV,	,, 9.
	45.	Marginulina glabra, D'O.	,,	I,	,, 26.
	46.	— raphanus, D'O.	,,	I,	,, 21.
	47.	Cristellaria cultrata, Montfort	,,	I,	,, 24, 25.
Type.—POLYMORPHINA LACTEA, *W. & J.*	48.	Polymorphina lactea, W. & J.	,,	I,	,, 48.
	49.	— gibba, D'O.	,,	I,	,, 49—51.
	50.	— Thouini, D'O.	,,	I,	,, 59.
	51.	— problema, D'O.	,,	I,	,, 64.
	52.	— complanata, D'O.	,,	I,	,, 52, 53, 60.
	53.	— gutta, D'O.	,,	I,	,, 46, 47.
	54.	— tubulosa, D'O.	,,	I,	,, 70—76.
	55.	— compressa, D'O.*	,,	I,	,, 54, 65, 77—80.
	56.	— rugosa, D'O. (not figured).			
	57.	Dimorphina nodosaria, Reuss	,,	I,	,, 55—58, 61.
	58.	— tuberosa, D'O.	,,	I,	,, 66.
Type.—UVIGERINA PYGMÆA, *D'O.*	59.	Uvigerina irregularis, Brady (not figured)			

* Also *Polymorphina frondiformis*, Wood, Pl. I, figs. 62, 63, 69, and Pl. IV, figs. 11—14; and *P. variata*, nov., Pl. I, figs. 67, 68.

Family—GLOBIGERINIDA.

Type.—Ovulites margaritula, *Lam.*	60.	Ovulites elongata, Lam. (not figured).		
Type.—Globigerina bulloides, *D'O.*	61.	Globigerina bulloides, D'O.	Plate II,	Figs. 1, 2.
Type.—Pullenia sphæroides, *D'O.*	62.	Pullenia sphæroides, D'O.	„ II,	„ 31, 32.
Type.—Textularia agglutinans, *D'O.*	63.	Textularia agglutinans, D'O.	„ III,	„ 14—16.
	64.	— trochus, D'O.	„ III,	„ 17, 18.
	65.	— gibbosa, D'O.	„ III,	„ 10—13.
	66.	— sagittula, Defr.	„ III,	„ 7—9.
	67.	Verneuilina communis, D'O.	„ III,	„ 19.
Type.—Bulimina Preslii, *Reuss*	68.	Bulimina elegans, D'O.		
	69.	— aculeata, D'O.	„ III,	„ 1, 2.
	70.	— marginata, D'O.	„ III,	„ 5, 6.
	71.	Bolivina punctata, D'O.	„ III,	„ 3, 4.
Type.—Cassidulina lævigata, *D'O.*	72.	Cassidulina lævigata, D'O.	„ IV,	„ 15.
	73.	— oblonga, Reuss.	„ IV,	„ 16.
	74.	— crassa, D'O. (not figured).		
Type.—Spirillina vivipara, *Ehrb.*	75.	Spirillina vivipara, Ehrb.	„ III,	„ 20—22.
Type.—Discorbina turbo, *D'O.*	76.	Discorbina rosacea, D'O.	„ IV,	„ 17.
	77.	— Parisiensis, D'O.	„ II,	„ 14, 15.
Type.—Planorbulina farcta, *F. & M.*	78.	Planorbulina Mediterranensis, D'O.	„ II,	„ 3.
	79.	— Ungeriana, D'O.	„ II,	„ 11—13.
	80.	— Haidingerii, D'O.	„ IV,	„ 18.
	81.	Truncatulina lobatula, W. & J.	„ II,	„ 4—10.
			„ IV,	„ 19.
	82.	— refulgens, Montf. (not figured).		
Type.—Pulvinulina repanda, *F. & M.*	83.	Pulvinulina repanda, F. & M.	„ II,	„ 22—24.
	84.	— pulchella, D'O.	„ II,	„ 25—27.
	85.	— auricula, F. & M.	„ II,	„ 33—35.
	86.	— Karsteni, Reuss.	„ II,	„ 28—30.
	87.	— elegans, D'O. (not figured).		
Type.—Rotalia Beccarii, *Linn.*	88.	Rotalia Beccarii, Linn.	„ II,	„ 19—21.
	89.	— orbicularis, D'O. (not figured).		
Type.—Calcarina Spengleri, *Gm.*	90.	Calcarina rarispina, D'O.	„ II,	„ 16—18.
Type.—Tinoporus vesicularis, *P. & J.*	91.	Tinoporus lævis, P. & J. (not figured).		

Family—NUMMULINIDA.

Type.—Amphistegina vulgaris, *D'O.*	92.	Amphistegina vulgaris, D'O.	Plate II,	„ 46—48.
Type.—Nummulina perforata, *Montfort*	93.	Nummulina planulata, Lam.	„ II,	„ 51, 52.
	94.	Operculina complanata, Defr.	„ II,	„ 49, 50.
Type.—Polystomella crispa, *Linn.*	95.	Polystomella crispa, Linn.	„ II,	„ 40—43.
	96.	— macella, F. & M. (not figured).		
	97.	— striato-punctata, F. & M.	„ II,	„ 38, 39.
	98.	Nonionina scapha, F. & M.	„ II,	„ 36, 37, 44, 45.
	99.	— faba, F. & M. (not figured).		
Type.—Orbitoides Faujasii, *Defr.*	100.	Orbitoides Faujasii, Defr.	„ III,	„ 25.

APPENDIX II.

TABLE SHOWING THE DISTRIBUTION OF THE FORAMINIFERA IN THE CRAG DEPOSITS

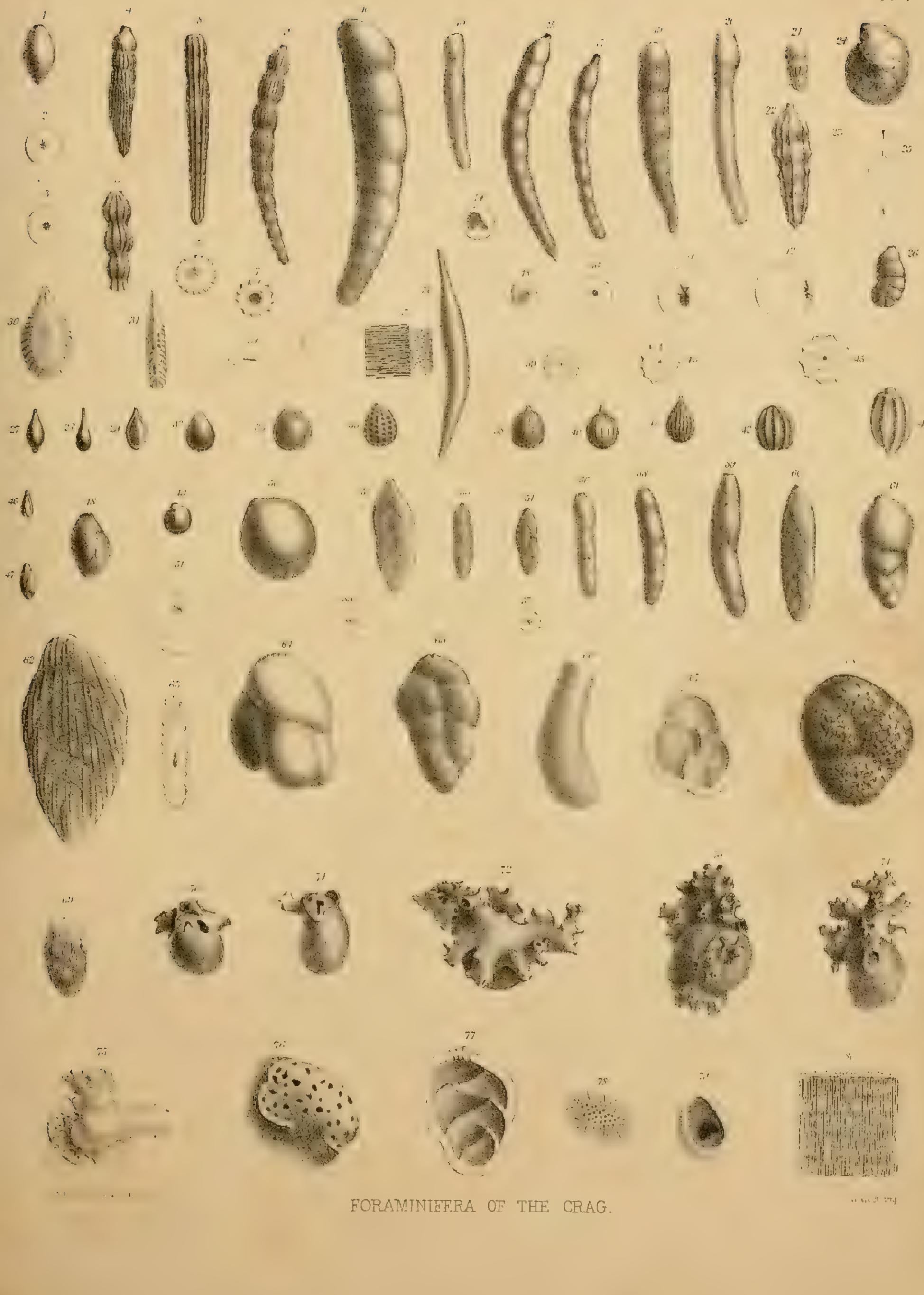
vl. Very large. *l.* Large. *m.* Middle-sized. *s.* Small. *rs.* Rather small. *vs.* Very small.
VC. Very common. C. Common. RC. Rather common. R. Rare. VR. Very rare.

	LOWER (WHITE, POLYZOAN, OR SUFFOLK) CRAG.						UPPER CRAG.								
								Fluvio-marine Beds.							
Genera, Species, and Varieties.	From Sutton (Mr. Wood's Collection).	Sutton (not Mr. Wood's).	Crag full of *Polyzoa*. (Sudbourne, &c.)	Shelly Crag from Sudbourne, Gedgrave, Aldborough, &c.	Crag with *Cardita senilis*.	Crag with *Cyprina Islandica*.	Red Crag; Essex, &c.	Southwold.	Thorpe.	Bramerton.	Chillesford Beds.	Bridlington Crag.	Living in the North Atlantic.	Living in the Arctic Seas.	
1. Cornuspira foliacea, Ph.	vl C	...	...	...	...	...	...	...	...	...	...	*	...	*	1
2. — involvens, Reuss	l C	...	...	...	...	...	...	...	...	...	...	...	...	...	2
3. Biloculina ringens, Lamk.	vl VC	m R	...	...	...	...	m VR	...	...	...	...	*	...	*	3
4. — elongata, D'O.	...	...	...	...	...	...	m VR	...	...	...	...	*	*	...	4
5. — depressa, D'O.	m C	...	...	...	...	...	...	...	...	...	...	...	*	...	5
6. Triloculina tricarinata, D'O.	vl R	...	...	...	...	...	...	...	...	...	...	...	...	...	6
7. — oblonga, Montag.	vl C	...	...	...	s VR	...	...	...	...	...	...	*	...	*	7
8. Quinqueloculina triangularis, D'O.	l C	m R	s RC	...	...	...	...	...	...	...	...	*	*	...	8
9. — seminulum, Linn.	vl C	m R	...	s VR	...	...	*	...	...	...	...	*	*	*	9
10. — subrotunda, Montag.	...	m R	...	...	...	...	...	...	...	...	...	...	...	*	10
11. — tenuis, Czjzek	...	...	...	s VR	...	...	...	...	...	...	...	...	*	...	11
12. — Ferussacii, D'O.	...	...	...	l R	...	...	...	...	...	...	...	...	...	*	12
13. — pulchella, D'O.	vl VR	...	...	...	...	...	...	...	...	...	...	...	...	...	13
14. — Brongniartii, D'O.	l R	...	...	...	...	...	...	...	...	...	...	...	...	...	14
15. Spiroloculina planulata, Lamk.	vl C	...	s R	...	...	...	...	...	...	...	...	...	*	...	15
16. — canaliculata, D'O.	l C	...	...	...	...	...	...	...	...	...	...	...	...	...	16
17. Dendritina arbuscula, D'O.	...	...	...	s VR	...	...	...	...	...	...	...	...	...	...	17
18. Spirolina cylindracea, Lam.	...	...	...	s VR	...	...	...	...	...	...	...	...	...	...	18
19. Orbiculina adunca, F. & M.	m VR	...	...	...	...	...	...	...	...	...	...	...	...	...	19
20. — compressa, D'O.	m R	...	...	...	...	...	...	...	...	...	...	...	...	...	20
21. Orbitolites orbiculus, Forsk.	m R	...	...	...	...	...	...	...	...	...	...	...	...	...	21
22. Alveolina, sp.	...	...	m VR	...	...	...	...	...	...	...	...	...	...	...	22
23. Webbina hemisphærica, nov.	s R	...	...	...	...	...	...	...	...	...	...	...	...	...	23
24. Lagena globosa, Montag.	...	s R	...	m VR	m RC	l RC	...	...	...	...	...	*	*	...	24
25. — lævis, Montag.	m VR	s VR	...	...	...	...	...	...	...	...	...	...	*	*	25
26. — semistriata, D'O.	s R	...	...	...	...	...	...	...	...	...	...	...	...	*	26
27. — striata, D'O.	...	...	...	m VR	...	...	...	...	...	...	...	...	...	...	27
28. — sulcata, W. & J.	vl C	m C	l C	m RR	m C	l RC	m VR	...	s R	...	...	*	*	*	28
29. — melo, D'O.	...	...	s VR	...	m R	...	...	...	...	...	...	...	...	*	29
30. — squamosa, Montag.	...	...	...	...	...	...	...	...	...	...	...	*	*	*	30
31. — marginata, Montag.	...	s VR	...	m RR	m RC	l RC	m VR	...	...	...	...	...	*	*	31
32. — ornata, Will.	m R	m VR	...	...	...	...	...	...	...	...	...	...	...	*	32
33. — apiculata, Rss.	...	...	s R	...	...	...	...	...	...	...	...	...	*	*	33
34. — gracillima, Seg.	vl VR	...	...	...	...	...	...	...	...	...	...	...	...	*	34
35. Glandulina lævigata, D'O.	l RC	...	...	...	...	...	...	...	...	...	...	...	...	*	35
36. Nodosaria raphanus, Linn.	s R	...	...	...	...	...	...	...	s R	...	...	...	*	...	36
37. — raphanistrum, Linn.	s R	...	...	...	...	...	...	...	...	...	...	...	...	...	37
38. — scalaris, Batsch.	...	s VR	...	s VR	...	vs VR	...	...	...	...	...	...	*	...	38
39. Dentalina pauperata, D'O.	l C	...	...	...	...	...	...	...	...	...	...	...	*	*	39
40. — obliquestriata, Rss.	l R	...	...	...	...	...	...	...	...	...	...	...	...	...	40
41. — brevis, D'O.	...	...	...	...	...	...	...	...	...	...	...	*	...	...	41
42. — obliqua, Linn.	l C	...	...	...	...	...	...	...	...	...	...	...	...	...	42
43. Vaginulina linearis, Montag.	l VR	...	...	...	...	...	...	...	...	...	...	...	...	*	43
44. — lævigata, Roemer	...	...	...	...	...	...	...	...	...	...	...	*	...	...	44
45. Marginulina glabra, D'O.	s VR	...	...	...	...	...	...	...	...	...	...	...	...	*	45
46. — raphanus, D'O.	m R	...	...	...	...	...	...	...	...	...	...	...	...	...	46
47. Cristellaria cultrata, Montag.	m VR	...	...	...	...	...	...	...	...	...	...	*	*	*	47
48. Polymorphina lactea, W. & J.	vl VC	m R	l C	s R	m RC	m RC	*	s VC	s R	...	vs VR	*	...	*	48
49. — gibba, D'O.	vl VC	s R	l R	s R	m RC	m RC	s VR	...	...	...	...	...	...	...	49
50. — Thouini, D'O.	l C	...	...	m RC	m RC	...	...	...	...	...	...	*	...	...	50
51. — problema, D'O.	l C	...	...	...	...	...	...	...	...	...	...	...	...	...	51
52. — rugosa, D'O.	...	m RR	...	...	...	...	...	...	...	...	...	...	...	...	52
53. — complanata, D'O.	vl VC	...	l C	m VR	...	...	*	...	...	...	...	...	...	...	53
54. — gutta, D'O.	vl VC	m RR	l VC	m RL	m RC	m RC	...	...	...	...	...	...	...	...	54
55. — tubulosa, D'O.	vl VC	...	...	...	...	m RC	...	...	...	...	...	...	...	*	55
56. — compressa, D'O.†	vl VC	...	l VC	...	...	...	...	s VC	...	...	...	...	...	*	56
57. Dimorphina nodosaria, Reuss.	l R	...	...	...	...	...	...	...	...	...	...	...	...	...	57
58. — tuberosa, D'O.	l R	...	...	...	...	...	...	...	...	...	...	...	...	...	58
59. Globigerina bulloides, D'O.	vs VR	s RR	s RR	m RR	s RC	...	...	vs VR	...	...	...	...	*	*	59
60. Pullenia sphæroides, D'O.	m RC	m VR	...	m RR	m RC	m RR	s VR	...	...	...	...	...	*	*	60
61. Textularia agglutinans, D'O.	vl VC	...	...	m RC	m RC	m RR	...	...	...	...	...	...	...	*	61
62. — trochus, D'O.	l C	s RR	s RR	m RC	...	m RR	...	...	...	...	...	...	...	...	62
63. — gibbosa, D'O.	vl VC	...	l RR	l R	m RC	m RC	...	...	...	...	...	...	...	...	63
64. — sagittula, Defr.	m C	s RC	s C	s C	m RC	s C	m RR	...	...	...	...	...	*	...	64
65. Verneuilina communis, D'O.	m VR	...	...	...	...	...	...	...	...	...	...	...	...	...	65
66. Bulimina elegans, D'O.	...	...	...	...	...	...	...	...	...	...	vs R	...	...	...	66
67. — aculeata, D'O.	...	...	...	...	...	...	...	vs VR	...	...	...	...	*	*	67
68. — marginata, D'O.	...	...	...	...	...	s R	...	...	...	...	...	...	*	...	68
69. Bolivina punctata, D'O.	...	...	...	...	...	s R	...	...	...	...	...	...	*	...	69
70. Cassidulina lævigata, D'O.	...	...	...	m VR	...	...	...	...	...	...	...	*	*	*	70
71. — oblonga, Reuss.	s R	...	...	m VR	...	...	...	...	...	...	...	...	...	...	71
72. — crassa, D'O.	...	...	s VR	m VR	...	...	...	...	...	...	...	...	*	*	72
73. Uvigerina irregularis, Brady	...	...	...	...	...	...	m VR	...	...	...	...	...	...	...	73
74. Ovulites elongata, Lam.	...	...	...	m VR	...	...	...	...	...	...	...	...	...	...	74
75. Spirillina vivipara, Ehrenb.	...	m VR	...	...	...	...	...	...	...	...	...	...	...	*	75
76. Discorbina rosacea, D'O.	...	...	...	s VR	...	...	...	vs VR	...	...	...	...	*	...	76
77. — Parisiensis, D'O.	rs R	m RR	m RC	s R	s RC	s RC	s R	...	...	...	...	...	...	...	77
78. Planorbulina Mediterranensis, D'O.	s R	m RR	...	...	...	...	...	...	...	...	...	...	*	...	78
79. — Ungeriana, D'O.	m C	...	...	...	...	...	...	...	...	...	...	...	*	...	79
80. — Haidingerii, D'O.	m C	...	...	s R	...	...	...	...	...	...	...	...	*	...	80
81. Truncatulina lobatula, W. & J.	...	s VC	m VC	l C	m C	m RC	s C	s VC	m RC	...	s R	*	*	*	81
82. — refulgens, Montf.	...	...	...	...	...	...	m R	...	...	...	...	...	...	...	82
83. Pulvinulina repanda, F. & M.	vl RC	...	m R	...	...	...	...	...	...	...	...	...	...	...	83
84. — pulchella, D'O.	m C	...	...	...	...	...	...	...	...	...	...	...	...	...	84
85. — auricula, F. & M.	m R	l VR	...	...	...	...	...	...	...	...	...	...	...	...	85
86. — Karsteni, Reuss.	...	...	...	...	...	...	...	s R	...	...	...	...	*	*	86
87. — elegans, D'O.	...	l VR	...	...	...	...	...	...	...	...	...	...	*	...	87
88. Rotalia Beccarii, Linn.	rs RC	s RR	m C	m R	m C	vs C	m C	s VC	m C	...	vs VC	...	*	...	88
89. — orbicularis, D'O.	...	s R	...	...	...	...	...	...	...	...	...	...	*	...	89
90. Calcarina rarispina, D'O.	rs R	s RR	m VC	m RC	...	...	s R	...	...	...	...	...	...	...	90
91. Amphistegina vulgaris, D'O.	*	...	* ?	...	...	...	...	...	...	...	...	...	...	...	91
92. Nummulina planulata, Lam.	...	...	* ?	...	...	...	...	...	...	...	...	...	...	*	92
93. Operculina complanata, Defr.	...	...	* ?	...	...	...	...	...	...	...	...	...	...	...	93
94. Tinoporus lævis, P. & J.	...	...	m VR	...	...	...	...	...	...	...	...	...	...	...	94
95. Polystomella crispa, Linn.	rs R	m RC	m VC	rs RR	m RC	s RC	m R	s R	m R	*	s R	...	*	*	95
96. — macella, F. & M.	...	m RR	m C	...	...	...	...	...	...	...	...	...	...	...	96
97. — striato-punctata, F. & M.	s R	...	...	m C	s RC	...	s C	m VC	m C	*	m VC	*	*	*	97
98. Nonionina faba, F. & M.	...	m RC	l R	...	...	...	l VR	...	...	...	...	...	...	*	98
99. — scapha, F. & M.	l VC	m RC	m R	m C	l C	l C	s R	...	...	...	...	*	*	*	99
100. Orbitoides Faujasii, Defr.	...	...	*	* ?	...	...	...	...	...	...	...	...	...	...	100
Number of Species and noticeable Varieties in the several Deposits	62	30	30	33	20	20	20	10	7	2	6	15	36	37	
	Sutton (Mr. Wood's).	Sutton (not Mr. Wood's).	With *Polyzoa*.	Shelly; Sudbourne, &c.	With *Cardita senilis*.	With *Cyprina Islandica*.	Red Crag; Essex, &c.	Southwold.	Thorpe.	Bramerton.	Chillesford.	Bridlington Crag.	North Atlantic.	Arctic Ocean.	
	Lower Crag.						Upper Crag.								

† *Polymorphina frondiformis*, Wood (*vl* VC), and *P. variata*, nov. (*l* R), should also have been inserted in the column of the species and varieties collected at Sutton by Mr. S. V. Wood.

PLATE I.

No. of Figure.		Magnified.	Locality from which the figured specimen was taken.
1.	*Glandulina lævigata,* side view	× 12 diam.	Sutton.
2.	— — end view, showing aperture . . .	× 15 ,,	,,
3.	— — ,, ,, ...		
4.	*Nodosaria raphanus,* side view (slender form)	× 12 ,,	,,
5.	— — end view, showing aperture . . .	× 18 ,,	,,
6.	— *raphanistrum* side view (a fragment) . . .	× 12 ,,	,,
7.	— — end view	× 18 ,,	,,
8.	— — side view (nearly perfect specimen) . .	× 12 ,,	,,
9.	*Dentalina obliqua,* side view	× 12 ,,	,,
10.	*Vaginulina linearis,* side view	× 12 ,,	,,
11.	— — end view, showing central aperture . . .		
12.	— — ,, ,, eccentric aperture . . .		
13.	*Dentalina pauperata,* side view (of irregular growth) . . .	× 12 ,,	,,
14.	— — end view, showing broken aperture . . .	× 18 ,,	,,
15.	— — side view (large specimen) . . .	× 12 ,,	,,
16.	— — end view, showing aperture . . .	× 18 ,,	,,
17.	— — side view	× 12 ,,	,,
18.	— — end view, showing aperture . . .	× 18 ,,	,,
19.	— *obliquestriata,* side view	× 12 ,,	,,
20.	— *pauperata* (of compact growth)	× 12 ,,	,,
21.	*Marginulina raphanus,* side view	× 12 ,,	,,
22.	*Nodosaria* — side view, much enlarged . . .	× 36 ,,	Thorpe.
23.	— — outline	× 12 ,,	,,
24.	*Cristellaria cultrata,* side view	× 12 ,,	,,
25.	— — edge view		
26.	*Marginulina glabra,* side view	× 12 ,,	,,
27.	*Lagena apiculata,* side view	× 12 ,,	,,
28.	— *lævis,* side view	× 12 ,,	Sutton.
29.	— *ornata,* side view	× 12 ,,	*Cardita senilis* Crag.
30.	— — side view, much enlarged	× 25 ,,	,,
31.	— — edge view, much enlarged	× 25 ,,	,,
32.	— *globosa,* side view	× 12 ,,	,,
33.	— *marginata,* side view	× 12 ,,	,,
34.	— — end view, showing aperture	× 12 ,,	,,
35.	— *melo*	× 12 ,,	,,
36.	— *gracillima*	× 12 ,,	Sutton.
37.	— — portion of shell-wall of same, more highly magnified, showing tubular structure	× 200 ,,	,,
38.	— *striata,* side view	× 12 ,,	,,
39.	— — end view, showing aperture . . .		
40.	— *sulcata,* side view (tending towards *L. striata*) . . .	× 12 ,,	,,
41.	— — side view (tending towards *L. striata*)		
42.	— — side view (strong form)	× 12 ,,	,,
43.	— — end view, showing aperture	× 12 ,,	,,
44.	A chamber of *Nodosaria raphanistrum* (a "derived" fossil) . .	× 12 ,,	Clacton.
45.	— — end view . . .	× 12 ,,	,,
46.	*Polymorphina gutta,* side view	× 12 ,,	Sutton.
47.	— — side view	× 12 ,,	,,
48.	— *lactea,* side view	× 12 ,,	,,
49.	— *gibba,* side view	× 12 ,,	,,
50.	— — side view	× 12 ,,	,,
51.	— — end view, showing aperture . . .		
52.	— *complanata,* side view	× 12 ,,	,,
53.	— — end view, showing aperture . . .		
54.	— *compressa,* side view	× 12 ,,	,,
55.	*Dimorphina nodosaria,* side view	× 12 ,,	,,
56.	— — side view	× 12 ,,	,,
57.	— — end view, showing aperture . . .		
58.	— — side view	× 12 ,,	,,
59.	*Polymorphina Thouini,* side view	× 12 ,,	,,
60.	— *complanata,* side view	× 12 ,,	,,
61.	*Dimorphina nodosaria,* side view (short individual) . . .	× 12 ,,	,,
62.	*Polymorphina frondiformis,* side view	× 12 ,,	,,
63.	— — end view, showing aperture . . .		
64.	— *problema,* side view	× 12 ,,	,,
65.	— *compressa,* side view	× 12 ,,	,,
66.	*Dimorphina tuberosa,* side view	× 12 ,,	,,
67.	*Polymorphina variata,* interior	× 12 ,,	,,
68.	— — side view	× 12 ,,	,,
69.	— *frondiformis* (small), side view	× 12 ,,	,,
70—75.	— *tubulosa*	× 12 ,,	,,
76.	— — portion of perforated septum . . .	× 36 ,,	,,
77.	— *compressa* (interior)	× 12 ,,	,,
78.	— — radiated aperture	× 24 ,,	,,
79.	— — simple aperture communicating between the chambers	× 24 ,,	,,
80.	— — portion of shell-wall, showing its minute structure .	× 200 ,,	,,



FORAMINIFERA OF THE CRAG.

PLATE II.

No. of Figure.		Magnified.	Locality from which the figured specimen was taken.
1.	*Globigerina bulloides*, upper surface	× 12 diam.	Sutton.
2.	— — lower surface	×	
3.	*Planorbulina Mediterranensis*, upper surface	× 12 ,,	,,
4.	*Truncatulina lobatula*, upper surface	× 12 ,,	,,
5.	— — ,,	× 12 ,,	,,
6.	— — edge view	× 12 ,,	,,
7.	— — lower surface	× 12 ,,	,,
8.	— — lower surface	× 12 ,,	,,
9.	— — edge view	× 12 ,,	,,
10.	— — upper surface	× 12 ,,	,,
11.	*Planorbulina Ungeriana*, lower surface	× 12 ,,	,,
12.	,, ,, upper surface		
13.	*Discorbina Parisiensis*, edge view	× 12 ,,	,,
14.	— — lower surface		
15.	— — upper surface		
16.	*Calcarina rarispina*, upper surface	× 12 ,,	,,
17.	— — upper surface (?)		
18.	— — edge view		
19.	*Rotalia Beccarii*, upper surface	× 12 ,,	,,
20.	— — lower surface		
21.	— — edge view		
22.	*Pulvinulina repanda*, upper surface	× 12 ,,	,,
23.	— — lower surface		
24.	— — edge view		
25.	— *pulchella*, upper surface	× 12 ,,	,,
26.	— — lower surface		
27.	— — edge view		
28.	— *Karsteni*, upper surface	× 30 ,,	,,
29.	— — lower surface	× 30 ,,	
30.	— — outline of the same size as the other magnified figures	× 12 ,,	
31.	*Pullenia sphæroides*, side view	× 12 ,,	,,
32.	— — edge view	× 12 ,,	
33.	*Pulvinulina auricula*, upper surface	× 12 ,,	,,
34.	— — lower surface	× 12 ,,	
35.	— — edge view	× 12 ,,	
36.	*Nonionina scapha*, side view	× 12 ,,	,,
37.	— — edge view		
38.	*Polystomella striato-punctata*, side view	× 12 ,,	,,
39.	— — edge view		
40.	— *crispa*, side view	× 12 ,,	,,
41.	— — edge view		
42.	— — side view	× 12 ,,	,,
43.	— — edge view		
44.	*Nonionina Labradorica*, side view	× 12 ,,	,,
45.	— — edge view		
46.	*Amphistegina vulgaris*, side view; a "derived" fossil (?)	× 12 ,,	,,
47.	— — side view		
48.	— — edge view		
49.	*Operculina complanata*, side view; a "derived" fossil (?)	× 12 ,,	,,
50.	— — edge view		
51.	*Nummulina planulata*, side view; a "derived" fossil (?)	× 12 ,,	,,
52.	— — edge view		

George West lith ad nat

FORAMINIFERA OF THE CRAG.

W. West imp

PLATE III.

No. of Figure.		Magnified.	Locality from which the figured specimen was taken.
1.	*Bulimina aculeata*, side view	× 30 diam.	*Cypr. Islandica* Crag.
2.	— — outline—relative size	× 12 ,,	
3.	*Bolivina punctata*, side view	× 30 ,,	,, ,,
4.	— — outline—relative size	× 12 ,,	
5.	*Bulimina marginata*, side view	× 30 ,,	Southwold.
6.	— — outline—relative size	× 12 ,,	
7.	*Textularia sagittata*, side view	× 12 ,,	Sutton.
8.	— — end view		
9.	— — side view	× 12 ,,	,,
10.	— *gibbosa*, side view	× 12 ,,	,,
11.	— — end view		
12.	— — specimen partially laid open, showing subdivided chamber	× 12 ,,	,,
13.	— — monstrous double specimen	× 12 ,,	,,
14.	— *agglutinans*, side view	× 12 ,,	,,
15.	— — end view		
16.	— — transverse section, showing subdivided chamber		
17.	— *trochus*, side view	× 12 ,,	,,
18.	— — end view		
19.	*Verneuilina communis*, side view	× 12 ,,	,,
20.	*Spirillina vivipara*, side view	× 36 ,,	,,
21.	— — edge view	× 36 ,,	
22.	— — outline—relative size	× 12 ,,	
23.	Hemispherical shell of an organism possibly allied to *Dactylopora*; a "derived" fossil	*a* × 50 ,, *b* × 8 ,,	?
24.	,, ,, another specimen; oblique view	× 50 ,,	
25.	*Orbitoides Faujasii*, side view; a "derived" fossil (?)	× 12 ,,	Sudbourne.
26.	*Biloculina ringens*, side view	× 12 ,,	Sutton.
27.	— — end view		
28.	— — thick variety	× 12 ,,	,,
29.	— *depressa*, side view	× 12 ,,	,,
30.	— — end view		
31.	*Triloculina oblonga*, side view	× 12 ,,	,,
32.	— — end view		
33.	— *tricarinata*, side view	× 12 ,,	,,
34.	— — end view		
35.	*Quinqueloculina seminulum*, side view	× 12 ,,	,,
36.	— — end view		
37.	*Spiroloculina planulata*, side view	× 12 ,,	,,
38.	— — end view		
39.	— *canaliculata*, side view	× 12 ,,	,,
40.	— — end view		
41.	*Quinqueloculina Brongniartii*, side view	× 12 ,,	,,
42.	— — end view		
43.	*Orbiculina compressa*, side view	× 5 ,,	,,
44.	— *adunca*, side view	× 12 ,,	,,
45.	*Orbitolites orbiculus*, side view	× 12 ,,	,,
46.	— — portion of edge of a complex specimen showing apertures	× 70 ,,	,,
47.	— — section of a portion of ditto, showing the connection of the chambers	× 70 ,,	,,
48.	*Dendritina arbuscula*, side view	× 12 ,,	,,
49.	— — face of terminal chamber, showing the aperture	× 12 ,,	,,
50.	*Cornuspira foliacea*, side view	× 12 ,,	,,
51.	— — edge view, showing aperture		
52.	— *involvens*, side view	× 24 ,,	,,
53.	— — edge view, showing aperture		
54.	— — outline, showing relative size	× 12 ,,	,,

PL. III

FORAMINIFERA OF THE CRAG.

PLATE IV.

No. of Figure.			Magnified.	Locality from which the figured specimen was taken.
1.	*Quinqueloculina triangularis*, side view	.	× 24 diam.	Sutton.
2.	— *Brongniartii* ,,	. .	× 24 ,,	,,
3.	— *pulchella* ,,	. .	× 24 ,,	,,
4.	— *Ferussacii* ,,	. .	× 24 ,,	,,
5.	*Webbina hemisphærica* ,,	. .	× 60 ,,	,,
6.	*Lagena semistriata* ,,	. .	× 60 ,,	,,
7.	— *squamosa* ,,	. .	× 60 ,,	Bridlington.
8.	*Nodosaria scalaris* ,,	. .	× 36 ,,	Crag with Cyprina.
9.	*Vaginulina lævigata* ,,	. .	× 12 ,,	Bridlington.
10.	*Dentalina brevis* ,,	. . .	× 12 ,,	,,
11—14.	*Polymorphina frondiformis*, side views	.	× 12 ,,	Sutton.
15.	*Cassidulina lævigata* .	*a*, side view *b*, edge view	× 60 ,,	Bridlington.
16.	— *oblonga*, side view	. .	× 60 ,,	Sutton.
17.	*Discorbina rosacea* .	*a*, upper surface *b*, lower surface *c*, edge view	×110 ,,	Southwold.
18.	*Planorbulina Haidingerii*	*a*, upper surface *b*, lower surface *c*, edge view	× 24 ,,	Sutton.
19.	*Truncatulina lobatula* .	*a*, upper view *b*, edge view	× 36 ,,	Bridlington.

H.B.Brady del. C.West lith. W.West imp.

FORAMINIFERA OF THE CRAG

THE

PALÆONTOGRAPHICAL SOCIETY.

T. Rupert Jones
Foraminifera of the Crag
Part II

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LONDON

MDCCCXCV.

A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

PART II.

CONTAINING

PAGES i—vii, 73—210; PLATES V, VI, VII.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

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CONTENTS.

LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED IN PART II.

I. PORCELLANEA.

II. ARENACEA.

III. VITREA, HYALINA, vel PERFORATA (omitted in the text at page 175).

LIST OF WOODCUTS IN PART II.

CORRECTIONS IN THE EXPLANATIONS OF PLATES I—IV.

Plate I,	fig.	21,	should be	*Marginulina costata* (Batsch).
,,	,,	29—31,	should be	*Lagena lagenoides*, Williamson.
,,	,,	42, 43	,,	*Lagena acuticosta*, Reuss.
,,	,,	55—58	,,	*Polymorphina nodosaria*, Reuss.
,,	,,	61	,,	*Dimorphina tuberosa*, d'Orb.
,,	,,	66	,,	*Dimorphina compacta*, B., P., and J.
,,	,,	69	,,	*Polymorphina frondiformis*, S. V. Wood, Var. *lineata*, nov.
,,	,,	70—75	,,	tubulose forms of *Polymorphina gibba*, d'Orb.
,, II	,,	8—10	,,	*Truncatulina refulgens* (Montfort).
,,	,,	16—18	,,	*Rotalia calcar*, d'Orb.
,,	,,	22—24	,,	*Pulvinulina punctulata* (d'Orb.).
,,	,,	25—27	,,	*Pulvinulina repanda* (d'Orb.).
,,	,,	36, 37	,,	*Nonionina umbilicatula* (Montagu), thick variety.
,,	,,	44, 45	,,	*Polystomella* (*Nonionina*) *scapha* (F. and M.), thick variety.
,,	,,	51, 52	,,	*Nummulites Boucheri* (?), de la Harpe.
,, III	,,	7—9	,,	*Textilaria sagittula*, Defrance.
,,	,,	19	,,	*Bigenerina nodosaria*, d'Orb.
,,	,,	20—22	,,	*Spirillina vivipara*, Ehrenb., Var. *complanata*, nov.
,,	,,	23	,,	*Indeterminate*, worn *Orbulina ?*
,,	,,	24	,,	*? Polyzoon.*
,,	,,	31—34	,,	*Miliolina*, not *Triloculina.*
,,	,,	35, 36, 41, 42	,,	*Miliolina*, not *Quinqueloculina.*
,,	,,	45—47	,,	*Orbitolites complanatus*, Lamarck.
,,	,,	48, 49	,,	*Peneroplis* (*Dentritina*) *arbuscula* (d'Orb.).
,, IV	,,	1	,,	*Miliolina triangularis* (d'Orb.).
,,	,,	2	,,	*Miliolina bicornis* (W. and J.), Var. *Brongniartii* (d'Orb.).
,,	,,	3	,,	*Miliolina pulchella* (d'Orb.).
,,	,,	4	,,	*Miliolina Ferussacii*, (d'Orb.), Var.
,,	,,	7	,,	*Lagena reticulata* (Macgillivray).
,,	,,	8	,,	*Nodosaria proxima*, Silvestri.
,,	,,	18	,,	*Truncatulina Haidingeri* (d'Orb.).

CORRECTIONS FOR PART I.

Page 15, last line but one in the synonyms, *instead of* p. 466 *read* 470.
" 26, line 8 from bottom, *for* Schlotheim *read* Geinitz.
" " 7 " " Kirby " Kirkby.
" 32, 15th line of the synonyms, *instead of* Ib. *read* Ann. Mag. Nat. Hist., ser. 2.
" 34, 5th " " *for* 307 *read* 317.
" " 6th " " " p. 6 " pp. 268, 269; and *for* pl. i *read* pl. v.
" 40, line 2 from bottom, *for* Pliocene *read* Pleistocene.
" 44, 2nd line of the synonyms, *for* 319 *read* 318.
" " 4th " " " 40, 41 " 90, 91.
" 48, 52, 70, *for* Upper Trias of Chellaston " Lias of Leicestershire (?).
" 47, 48, 55, 59, 61, *for* Neuegeboren " Neugeboren.
" 47, line 17 from bottom, *for* 68 *read* 48.
Foot-note at page 61 " Marguline " Marginuline.
Page 64, line 8 from bottom, *for* Genus " Species.
" 69 " 2 " of text, *for* Smith's " Smithsonian.

CORRECTIONS FOR PART II.

Page 114, line 3 from top, *for* p. 33 *read* p. 107.
" 123 " 6 " " *Montagu* read *Walker and Jacob.*
" 157 " 1 and 2, TEXTULARIA GLOBULOSA, *Woodward and Thomas*, 1885 . . . . figs. 1—5 is T. GIBBOSA, and should be transferred to p. 153.
" 159 " 1 and 2 *read* Charente-Inf. Annales.
" " " 4 " (Rend.).
" " last line but one, *read* Ak. Wiss.
" 175, *insert before* LAGENIDÆ, &c.—

III. VITREA, HYALINA, *vel* PERFORATA.

Shell calcareous; perforate and hyaline in structure. (Those of the *Perforata* that in great part take on an *arenaceous* investment are included in the *Arenacea.*)

Cristellariæ have such narrow and much-curved chambers that they are separable as *C. vortex;* and there are other extreme conditions of variable features which have been conveniently adopted as grounds for separate names. Some *Cristellariæ* are not discoidal, but have become oval, and more or less oblong by the growth of segments that leave the spiral arrangement, and follow a nearly direct line, with their inner edges reaching down (backwards) to touch the spiral part of the shell; and they thus become elongate and either flattened, as *Cristellaria crepidula* (Fichtel and Moll), or thick and subtriangular in section, as *C. Italica* (Defrance). Others keep their later chambers quite free of the spire, like *C. subarcuatula* (Walker and Jacob), and thus pass into *Marginulina.*

There are other less marked distinctions of subordinate importance, depending upon surface-ornamentation, the thickening of the central portion of the shell into an umbo, and the septal lines into ribs, or other similar characters, due to exogenous shell-growth. The shape of the pseudopodial or stoloniferous orifice is, as in other Foraminifera, somewhat variable. In *C. cultrata* it is often triangular; and upon specimens having this peculiarity M. d'Orbigny founded his genus *Robulina.* Professor Williamson, Dr. Carpenter, and others have shown how untenable such a distinction really is.

Cristellaria calcar (Linné) serves as a central type for this sub-group of *Nodosarina.* We have already indicated the interchangeableness of the *Cristellariæ* with others of this great generic group. Without entering further upon the intricate polymorphism of *Cristellaria*, we proceed to describe our specimens from the Crag.

We begin with *C. cultrata* (Montfort); and ignoring the non-essential differences in carination, limbation, thickening of umbones, and relative size and gibbosity of the chambers, we have to draw up a very long list of synonyms for the little *Cristellaria* before us, which belongs to the form known as *C. cultrata.* Indeed, zoologically it is very difficult to separate *C. cultrata* from *C. rotulata* and *C. Italica* on one hand, or from *C. calcar* and *C. cassis* on the other, whilst the distinctions of ornament are found to fade away one into another. With the *Cristellariæ*, as with other Foraminiferal groups, we have to deal with the variability of individuals ; and for convenience of grouping and reference we must artificially define nominal species, varieties, and even sub-varieties. We confine ourselves, therefore, to the smooth, orbicular, keeled *Cristellariæ*, with a modicum of septal overgrowth and of umbonal thickening, as typical of *C. cultrata.*

PART II.

I. INTRODUCTORY REMARKS.

PART I of the Monograph of the Foraminifera of the Crag was unavoidably left unfinished in 1866. Two of the joint authors have unfortunately been removed from among us by death, and their fellow-worker has been hindered by many circumstances hitherto from completing the Monograph.

It is proposed that in PART II[1] additions and corrections, in many cases necessary, be made for the genera and species already dealt with; and that the descriptive work should comprise such groups as precede *Lagena* and its allies in the more modern classification. A considerable quantity of MS. prepared by the late Dr. H. B. Brady, after 1866 for this PART II, has been advantageously incorporated.

The descriptions will be rendered in as short a form as possible by limiting them to concise notes on the characters, distribution, and peculiarities of shape and structure, such as the same authors used in the "Memoir on the Foraminifera of the Abrohlos Bank" ('Trans. Zool. Soc.,' vol. xii, part 7, 1888, pp. 211—239); and as Dr. Egger has lately made use of in his "Memoir on the Foraminifera from the Soundings obtained by the 'Gazelle'" ('Abhandl. k. Bayer. Akad. Wiss.,' vol. xviii, part 2, 1893, pp. 195—266),—in each case references to the Report[2] on the Foraminifera brought home by the 'Challenger' being made for the synonymy down to 1884, as far as applicable and convenient. The system of classification, also, and of nomenclature used by Dr. H. B. Brady in that Report will be adhered to as much as possible. This plan has been followed by Dr. Carlo Fornasini ('Boll. Soc. Geol. Ital.,' 1889), by Signor M. Malagoli ('Atti Soc. Nat. Modena,' 1888) and others.

Having lately had opportunities of studying the original figured specimens of Foraminifera from the Crag—both those formerly in Mr. S. V. Wood's and those in Professor W. K. Parker's Collection—all being now in the British Museum (Natural-History Branch), we have been able to examine the figured

[1] Written in 1895.

[2] 'Report on the Foraminifera dredged by H.M.S. 'Challenger' during the years 1873—1876.' Reports of the Scientific Results of the Voyage of H.M.S. 'Challenger,' vol. ix (Zoology), 4to, London, 1884, pp. 814, with volume of 115 plates.

specimens as far as requisite, and to recognise some forms that had not been published in Part I.

Other sources of information have been several selected examples of Crag, collected by Professor Prestwich from the "Zones" defined by himself in 1871, and other samples specially taken from the several zones by Mr. H. W. Burrows. Long conversant with the fossils of the Crag, and with the Foraminifera in particular, Mr. Burrows, in co-operation with Mr. R. Holland, has worked assiduously on these microzoa; and they now enrich this Monograph with the results, both by excellent figures of the Foraminifera shown in Plates VI and VII, by the notes throughout this Part of the Monograph on the geographical and geological distribution of the several species, and by Tables of the genera and species. Mr. Burrows has also contributed the valuable stratigraphical notes on the divisions of the Crag. Other courteous and obliging friends—namely, Mr. C. D. Sherborn, Mr. F. W. Millett, and Mr. F. Chapman—have given valuable help in several ways in determining the relationship of the forms, and their bibliography and synonymy.

Plate V contains many of the forms selected from the old collections, which, after having been photographed, were lithographed, in company with some from Mr. Millett's and Mr. Chapman's collections, by Messrs. George West and Sons, with their usual conscientious exactitude. Plates VI and VII were lithographed by them from drawings kindly made by Messrs. Burrows and Holland, from specimens which, with the few exceptions noted in the Explanations of the Plates, are from their own collections, and have not been previously recorded from the Crag.

II. THE STRATIGRAPHY OF THE CRAG:

WITH NOTES ON THE DISTRIBUTION OF ITS FORAMINIFERA.

By Henry W. Burrows, A.R.I.B.A., &c.

CONTENTS.

Since the publication, in 1866, of the First Part of this Monograph, much light has been thrown upon the stratigraphical relations of the Crag deposits of this country and abroad, so that many modifications of the views then held have become necessary.

The whole of the Pliocene beds of the British Isles have been exhaustively dealt with by Mr. Clement Reid in his "Pliocene Deposits of Britain,"[1] to which is appended a full Bibliography of works relating to Pliocene strata, both English and foreign.[2]

The latest views on the subject are embodied in the following classification,

[1] 'Memoirs Geological Survey,' 1890.

[2] For the foreign equivalents to English Pliocene strata, and correlation of foreign Tertiary strata generally, consult G. F. Harris's "Approximate Correlation of the Tertiary Beds of Europe."

for which I am mainly indebted to the work referred to; but, to make a comparison with the First Part of this Monograph clearer, notes have been added in square brackets (see Table, p. 5).

The distribution of Foraminifera throughout this series will best be understood by discussing the several beds in detail.[1]

BRIDLINGTON BEDS.—It will be noticed that the so-called "Bridlington Crag" is omitted from the following classification, as that deposit is now definitely regarded as Pleistocene.[2] The Foraminifera indicated in the twelfth column of the "Table showing the Distribution of the Foraminifera in the Crag Deposits," Appendix II of the First Part of this Monograph, are therefore (unless for comparison) not further described.

NEWER PLIOCENE [UPPER CRAG].

BEDS ABOVE THE RED CRAG.—Our knowledge of the distribution of Foraminifera in the entire series of Upper Crag beds remains, unfortunately, in almost precisely the same condition as that tabulated in the list already referred to, with the following few additions for the Chillesford Beds of Aldeby, near Beccles.

Nodosaria raphanus (Linn.), vs. VR.[3]
Textilaria globulosa, Ehrenb., s. VR.
Polymorphina tuberculata, d'Orb., m. VR.
Planorbulina mediterranensis, d'Orb., m. VR.

RED CRAG.—The coarse quartzose sand and ferruginous condition of the Red Crag beds were not favorable to the presence and preservation of Foraminifera; but a more extended research in the finer and lighter coloured sands would, no doubt, prove profitable, although a prolonged search through some of the grey sand,

in R. B. Newton's 'Syst. List F. E. Edwards's Coll. British Oligocene and Eocene Mollusca' (Appendix), 1891, pp. 327—340.

For details of Belgian Pliocene stratigraphy see "Esquisse géologique et paléontologique des dépots pliocènes des environs d'Anvers," by E. Vanden Broeck, 'Ann. Soc. Malac. Belg.,' vol. ix, 1874, pp. 83—374; and of Italian Pliocene, &c., "Classification des Terrains tertiaires conformé à leurs facies," by F. Sacco, 'Bull. Soc. Belge de Géol.,' &c., vol. i, 1887, pp. 276—294.

[1] The remarks on the distribution of Foraminifera are based upon the examination of material collected by me during the past eight years, with the exception of some from Tattingstone and Gedgrave (Zone g) kindly given by Prof. Prestwich. The whole of this material has been worked over by Mr. R. Holland and myself; and Mr. F. Chapman gave us some assistance with the Tattingstone Crag. For complete lists see Appendix.

[2] For references see C. Reid, op. cit., p. 208.

[3] vs. very small; s. small; m. middling; VR. very rare.

Classification of the Pliocene Deposits of Britain, and their principal Foreign Equivalents.

	England.	Belgium and Holland.	Italy.
Pleistocene	Arctic Freshwater Bed (with *Salix polaris*, *Betula nana*, &c) [Mundelesy, Beeston, &c.]	?	Sicilian (with recent marine mollusca).
[Upper Crag] Newer Pliocene (Cold temperate)	*Leda* [= *Nuculana*] *myalis* Bed (classed provisionally with the Pliocene) [West Runton, Beeston, &c.]		Astian: Villafranchian sub-stage, Continental facies.
	Forest-bed series [Cromer, &c.]: Upper Fresh-water, Estuarine, Lower Fresh-water; Gravels with *Elephas meridionalis* at Dewlish		
	Weybourn Crag (and Chillesford Clay ?)		Astian: Fossanian sub-stage, Littoral and Estuarine facies.
	Chillesford Crag		
	Norwich [Fluvio-marine or Mammaliferous] Crag and *Scrobicularia* Crag		
	Red Crag of Butley, &c.		
	Walton Crag (Lower Red Crag)	Scaldisian; sands with *Chrysodomus antiqua*	Astian: Astian sub-stage, Marine facies.
[Lower Crag] Older Pliocene (Warm temperate)	St. Erth Beds [near Marazion, Cornwall]		
	"Coralline" [Suffolk, Lower, White, Bryozoan, or Zoophytic] Crag, and Lenham Beds	Casterlian; sands with *Glossus cor*. Diestian; sandstone and sands of Edeghem, with *Glycymeris Menardi*	Plaisancian. Fossiliferous blue argillaceous marls.
	[Nodule Beds] Box-stones and phosphate-beds at the base of the Red and Coralline Crags (with *remanié* early Pliocene fossils) [Sutton, Felixstowe, Foxhall, Waldringfield, &c.]		
	Wanting	Wanting	Messinian: An alternation of marls, sands with estuarine fossils, calcareous and gypseous deposits, thick sandstones and conglomerates.
Miocene	Wanting	Bolderian	Tortonian.

so rich in Mollusca, from Walton-on-the-Naze, has not resulted in any additions to the recorded species.

OLDER PLIOCENE [LOWER CRAG].

ST. ERTH BEDS.—At St. Erth, near Marazion, Cornwall, a very small outlier of sands and clays occurs, the Pliocene age of which was definitely established by the late Mr. S. V. Wood, jun.;[1] and later a full description of the exposure was given by Messrs. P. F. Kendall and R. G. Bell,[2] from which the following section is taken [with the dimensions added from Mr. C. Reid's 'Memoir,' p. 60]:

	Vegetable soil.
3 ft. to 7 ft..........	Bed 1. "Head," an argillaceous deposit with angular fragments of Killas and other rocks; probably of glacial origin.
	2. Fine yellow sand.
	3. Yellow clay, without fossils; separated from Bed 2 by a thin layer of coarse sand ("Growder").
1 ft. 6 in. to 3 ft....	4. Blue clay, with many fossils.
	5. Layer of scattered quartzose pebbles.
	6. Fine quartzose sand, yellow above and purplish below.
	7. Very coarse, highly ferruginous sand ("Growder").

The thickness of the several beds is very variable, and the total depth of the pit 12 feet to 14 feet. No. 4 is the fossiliferous bed, in which nearly all the organic remains were found.

The Foraminifera have been most carefully worked out by our friend Mr. Fortescue W. Millett, and the lists published by him[3] give a total of 163 species and well-marked varieties. Of this number seventy-six are also met with in the Coralline Crag, the additions now made to the rhizopodal fauna of the latter emphasising the similarity to a considerable degree.

Mr. Millett says in his "Additional Notes," "Every day the difficulty of ascertaining the age of any particular bed by the Foraminifera it contains becomes more evident; for rarely does it happen that an investigation is made of any deposit, recent or fossil, which does not extend our knowledge of the existence of

[1] "On a New Deposit of Pliocene Age at St. Erth, near the Land's End, Cornwall," 'Quart. Journ. Geol. Soc.,' vol. xli, 1885, pp. 65—73.

[2] "On the Pliocene Beds of St. Erth," 'Quart. Journ. Geol. Soc.,' 1886, pp. 201—215.

[3] F. W. Millett, "Notes on the Fossil Foraminifera of the St. Erth Clay Pits," 'Trans. Roy. Geol. Soc. Cornwall,' vol. x, pt. 7, 1885, pp. 213—216; "Additional Notes on the Foraminifera of the St. Erth Clay," op. cit., vol. x, 1886, pp. 222—226; "The Foraminifera of the Pliocene Beds of St. Erth," op. cit., vol. xi, 1894, pp. 655—661.

several species in localities or periods where they were before unknown. Thus, in this presumably Pliocene deposit, we have forms which hitherto have been known to exist only in Eocene or Miocene periods; whilst, on the other hand, there are several species which, now living in the seas in various parts of the world, are here for the first time found fossil."

To a certain extent this is undoubtedly true; but making allowance, as we should, for the difference of sea-bottom and the nature of each deposit—the St. Erth fossiliferous bed consisting of a fairly pure clay, and the Coralline Crag of Bryozoan and Molluscan detritus—we naturally expect to find considerable differences in the entombed organisms. We thus find a very rich assemblage of *Lagenæ* in the St. Erth beds (thirty-six species), while but *twenty-three* are recorded from the Coralline Crag, of which *eighteen* are common to the two. One of the most interesting recorded is *Lagena seminuda*, Brady, a species only met with at six stations by the 'Challenger,' two in the South Atlantic and four in the South Pacific, with a range of depth from 1300 to 2350 fathoms. In the St. Erth clay it is rare; but in the Coralline Crag at Sutton (Zone **f**) it is rather common, so that we have in the Pliocene the earlier appearance of a comparatively shallow-water form, which has since migrated to deeper seas. The *Polymorphinæ* so well represented in the Coralline Crag appear to be somewhat rare at St. Erth, but of the fifteen recorded species ten are also found in the Coralline Crag.

Taken altogether, the balance of evidence, so far as the Foraminifera are concerned, supports the arguments adduced by Mr. C. Reid for the inclusion of the St. Erth Beds with the *Older*, rather than with the *Newer* Pliocene, as suggested by Messrs. P. F. Kendall and R. G. Bell.[1]

As the scope of this Monograph is limited to the Foraminifera of the Crags of the Eastern Counties, it is not proposed to further describe the St. Erth forms, more especially as they have already been so ably dealt with by Mr. Millett; and we learn from him that "there are still many species undetermined, which will form the subject of a concluding notice." The species common to the Coralline Crag and St. Erth beds are tabulated in the Appendix.

CORALLINE CRAG.—As it is from this division of the Crag deposits that we have obtained by far the largest and best assortment of species of Foraminifera, its subdivisions will be more fully dealt with.

Subsequent to the publication of PART I of this Monograph Professor Prestwich[2] published his researches on these beds, and subdivided the Coralline Crag into several zones, to each of which he assigned an index letter. The total thickness

[1] For the relation of the St. Erth beds to those of Cotentin see C. Reid, 'Pliocene Deposits of Britain,' 1890, p. 67.

[2] J. Prestwich, "On the Structure of the Crag-beds of Suffolk and Norfolk." Part I. The Coralline Crag of Suffolk," 'Quart. Journ. Geol. Soc.,' vol. xxvii, 1871, p. 115, *et seq.*

of the deposit he estimated at 83 feet. In 1872 Messrs. S. V. Wood, jun., and F. W. Harmer[1] questioned "the constancy or determinability of such horizons;" and, by another method of calculation, arrived at the conclusion that the total thickness of the Coralline Crag does not exceed 60 feet. That there are two main divisions of the Coralline Crag is recognised by the several writers, and appended is a comparison of their views.

GENERAL SECTION OF THE CORALLINE CRAG.

After Professor Prestwich.						After Messrs. S. V. Wood, jun., and F. W. Harmer.
Zone.			Thickness.	Character of beds.	Localities.	
Upper Division 36′ 0″.	h		6′ 0″	Sand and comminuted shells	Sudbourne, Gedgrave	3‴. Bed reconstructed out of 3″ comminuted.
	g		30′ 0″	A series of beds consisting almost entirely of comminuted shells and remains of Bryozoa, forming a soft building stone. False stratification and oblique bedding are its constant characters	Sutton, Sudbourne, Gedgrave, Iken, Aldborough	3″. Solid bed of Molluscan remains, with various species of Bryozoa. "The Bryozoa rock-bed of the Coralline Crag."
Lower Division 47′ 0″.	f		5′ 0″	Sand with numerous entire shells and seams of comminuted shells	Sutton, Iken, Sudbourne, Gomer	
	e		12′ 0″	Sands with numerous Bryozoa, often in the original position of growth, and some small shells and Echini	Sutton, Broom Hill	
	d		15′ 0″	Comminuted shells, large entire or double shells, and bands of limestone in the upper part	Sutton, Broom Hill, Sudbourne, Iken, Tattingstone	3′. Calcareous sands, in some places more or less marly, rich in Molluscan remains. "The shelly sands of the Coralline Crag."
	c		10′ 0″	Marly beds with numerous well-preserved and double shells, often in the position in which they lived	Sutton, Ramsholt	
	b		4′ 0″	Comminuted shells, Cetacean remains, Bryozoa	Sutton	
	a		1′ 0″	Phosphatic nodules and Mammalian remains	Sutton	
Total		.	83′ 0″			Total thickness 60 feet.

[1] 'Supplement to the Crag Mollusca,' Palæontograph. Soc., 1872, p. ii, *et seq.*

1. Sutton and Ramsholt.—Zones **a**, **b**, and **c**.

The lowest zones of the Coralline Crag were exposed only in the long since disused pits at Sutton and Ramsholt. The old pit on Mr. Colchester's farm at Sutton, south side of Sutton Farm Hill, showed in 1860 the following section :[1]

	Surface soil	1′ 0″
Zone **d**.	White marly sands with seams of *Cyprina* [= *Arctica*]	17′ 0″
„ **c**.	Ditto with *Mya* and *Bryozoa* in lower part, and *Cardita*, *Astarte*, *Anomia*, and *Venus* common in upper part [This bed is stated to have been rich with Foraminifera]	
„ **b**.	Bed of comminuted shells, with single valves of *Cyprina* [= *Arctica*], *Pecten* [= *Chlamys*], *Cellepora cæspitosa*, &c.	4′ 0″
„ **a**.	Bed of phosphatic nodules, with Cetacean and other Mammalian remains and foreign boulders	1′ 0″
	[Nodule-Bed.]	
	London Clay.	

The Ramsholt pit was correlated with part of bed **c**.

2. Broom Hill.—Zones **d** and **e**.

Pit near the Keeper's Lodge, one mile west of Orford Church.

The following section is given by Prof. Prestwich :[2]

	Surface and drift soil	3′ 0″
Zone **e**.	Yellow sand, full of *Fascicularia*, *Alveolaria*, and *Cellepora*; few shells	7′ 0″
„ **d**.	Sandy bed with comminuted shells, thin bands of tabular limestone, layers of large and entire shells, and a few Bryozoa. The lower bed is full of fine entire *Cyprinæ*, *Thraciæ*, *Diplodontæ*, *Terebratulæ*, and *Carditæ*, often double	15′ 0″

The bed **d**, so far as I have seen on the many visits made to this pit, must have been somewhat lenticular and have thinned out, as it does not now (1894) exceed 10 to 12 feet in thickness.

Foraminifera are abundant in this section in both zones, as the lists appended show. In zone **d**, in addition to those forms common to most Coralline Crag exposures, *Polystomella crispa* is perhaps the most common, together with fine specimens of *P. macella*. Some of the *Polymorphinæ*, as *Polymorphina frondiformis*, *P. complanata*, *P. compressa*, and *P. gibba*, are very large and well grown; and the same remark applies to *Pulvinulina repanda*. *Cassidulina lævigata*, not usually a common form in the Coralline Crag, is also fairly plentiful in this zone. In zone we notice the same abundance of *Polystomella crispa*, large and well developed.

[1] Prof. Prestwich, 'Quart. Journ. Geol. Soc.,' vol. xxvii, 1871, p. 117.

[2] Op. cit., p. 122.

Other common species are *Textilaria sagittula*, *Truncatulina lobatula*, *T. Haidingerii*, and *Rotalia Beccarii*. On the other hand, *Nonioninæ* are rare and the specimens small. There is also a remarkable absence of Milioline forms.

3. Sudbourne Hall.—Zone **d.**

I measured the following section in the pit directly in front of the Hall in 1886, and it is still (1894) in the same condition.

	Surface soil and drift	1′ 6″
Zone d.	Fine white Coralline Crag, full of comminuted shells and Bryozoa, rich in *Scaladiæ*	3′ 0″
	Marly Crag, buff-coloured and greenish at the base; full of fine shells, *Cardita senilis*, *Arctica Islandica*, *Chlamys opercularis*, *Astarte Omalii*, &c.	3′ 6″

This pit is referred, somewhat doubtfully, by Prof. Prestwich to the Zone **d**; but the Mollusca, especially the band with *Arctica islandica*, in a greenish to buff-coloured Crag, so distinctive of this zone at Broom Hill, Sutton, and elsewhere, together with the Foraminifera, confirm this view. Some of the latter are here very fine; specimens of *Polymorphina frondiformis* 5 mm. long, and of *P. complanata* 4 mm. long, being not uncommon. *Polymorphina variata* is also plentiful and well grown, together with *Textilaria agglutinans* (varieties) and *T. trochus*.

4. Tattingstone (Park Farm).—Zone **d.**

We are indebted to Prof. Prestwich for some material from the outlier of Coralline Crag which occurs at this locality, four and a half miles south-south-west of Ipswich. The section is now much obscured and overgrown; but originally about eight feet of Coralline Crag was exposed, underlying Red Crag, in the following section:[1]

	1. Coarse gravel. Drift.	
Red Crag	2. Ochreous sand, with seams of ironstone, &c. . .	12′ 0″
	3. Crag with a few coprolites	
	4. Light-coloured sand	
	5. White sand	
	6. Brown loam	
	7. Not described	
	8. Coralline Crag	8′ 0″

The Coralline Crag of this section is referred, with doubt, by Prof. Prestwich to his zone **d**; but an examination of the Foraminifera shows a somewhat

[1] Prof. Prestwich, 'Quart. Journ. Geol. Soc.,' vol. xxvii, 1871, p. 342. See also, for other sections at Tattingstone, "Geology of Ipswich," &c., 'Mem. Geol. Surv.,' 1885, pp. 26 and 47.

different fauna from that of other localities referred to this zone. *Lagenæ* are fairly plentiful, the species *Lagena lacunata* and *L. melo*, which are not often met with in other exposures of Coralline Crag, being rather common. Other forms of Foraminifera are somewhat rare, with the exception of those species which range through the entire formation.

5. Sutton.—Zones **e**, **f**, and **g**.

The pits in this classical locality, well known to all students of the Coralline Crag, are now somewhat obscured, weathered, and overgrown. The celebrated Bullock-yard pit, about 250 yards south-west of Pettistree Hall, furnished the late Mr. S. V. Wood with the bulk of his extensive collection of Mollusca from this formation. On visiting the locality in August, 1894, a comparatively fresh exposure of the Crag was visible in the outlier, at some forty to fifty yards to the north of the Bullock-yard pit, and facing Pettistree Hall; it shows the following section:

	Surface soil, dark purple-brown	2′ 0″
Zone g.	Hard, ferruginous, false-bedded Coralline Crag; full of Bryozoa and shells, many broken	2′ 0″ to 3′ 0″
" f.	Buff sandy Crag; full of small shells, *Scala*, *Bullinella*, *Adeorbis*, *Ringicula*, *Chlamys*, &c.	5′ 0″
" e.	Buff-coloured marly Crag; very few shells, in scattered bands . .	4′ 6″

The Bullock-yard section shows the same sequence, but the zone **e** is 7 feet deep. In the sections published by Prof. Prestwich the bed **e** showed 4 feet, and bed **g** 11 feet. It would thus seem that the beds are lenticular and unevenly bedded.

The zone **g** is far too ferruginous to form a promising field of research for Foraminifera, and attention was therefore chiefly directed to zones **e** and **f**, which have yielded us a rich Foraminiferal fauna; but many of the forms recorded in the First Part of this Monograph have not been found, although they were then stated to be of common occurrence at Sutton. On this point Messrs. S. V. Wood, jun., and F. W. Harmer say,[1] "At this spot, moreover [Sutton, and by inference, supported by inquiries made at the locality, the Bullock-yard pit], Foraminifera were once abundant, and from it Mr. Wood collected all the species obtained by him from the Coralline Crag which are described in the Monograph of Messrs. Jones and Parker [and Brady]. No Foraminifera, however, have been found by him there for many years, although very many tons of the Crag from the same spot have been sifted by him for Mollusca during that period."

[1] 'Supplement to the Crag Mollusca,' Palæontograph. Soc., 1892, p. iv.

Despite the remarks quoted above, the Sutton pits still yield a rich Rhizopodal fauna, many of the species being fully grown and perfect, occurring in great profusion, notably in zone **f**, where we find *Polymorphina frondiformis*, *P. variata*, *P. gibba*, *P. complanata*, *P. communis*, *Textilaria gibbosa*, *Biloculina ringens*, &c.; while the *Lagenæ*, though somewhat rarer individually, are numerous in species. Some of the specimens are gigantic, comparatively speaking; *e. g.* *Dentalina pauperata*, 6 mm. long, *D. obliqua*, 7 mm. long, *Polymorphina nodosaria*, 4 mm. long, and *Dimorphina tuberosa*, 4 mm. long, are not infrequent. In zone **e**, the species common in the same zone at Broom Hill are also plentiful here; but *Nonionina scapha*, which is there somewhat rare, is very common, and the specimens well developed. Moreover *Miliolinæ* are rather common, as are also *Planorbulina mediterranensis* and *Discorbina rosacea*.

It seems probable, therefore, that the greater number of the Foraminifera recorded from Sutton in the First Part of this Monograph were from zone **f**; but, if that were not so, it is now impossible to separate those found in zone **e**.

6. Gedgrave.—Zones **f**, **g**, and **h**. These zones are well shown in the pits at High and Low Gedgrave, one and a half miles south-west of Orford, in the following sections, measured in August, 1894:

Pit close to High House, Gedgrave.

	Surface soil	
Zone h.	Sandy buff-coloured Coralline Crag (part of zone **g** reconstructed ?)	. 2′ 0″ to 3′ 0″
„ g.	Buff to yellow Coralline Crag, "the rock bed," a soft friable building stone in three distinct beds, false-bedded throughout, full of Bryozoa and shell detritus	About 17′ 0″ to bottom of pit; base not seen.

Pit at Low Farm, Gedgrave, close to the marshes, showing in part the downward succession of the High-House pit.

Zone f.	Yellow sandy Coralline Crag, of the usual characters, but even-bedded in part; full of Bryozoa and Mollusca . . .	. 3′ 6″ to 4′ 0″
	Pale buff-coloured Coralline Crag, current-bedded; full of small Mollusca, *Erato, Raphitoma, Cæcum, Trivia, Eulima, Nucula, Psammobia, Lucinopsis*, &c., with many species of Foraminifera . . .	3′ 0″
		Base not seen.

A small pit at Ferry Barn, half a mile to the south-west, also shows a good exposure of this bed, with Foraminifera and small Mollusca.

Zone **f**.—This is rich in Foraminifera, some of the species being large and striking, *e. g.* *Textilaria agglutinans*, *T. gibbosa*, *Polymorphina variata*, *P. frondiformis*, *P. compressa*, *P. complanata*, together with large, but rarer, *Biloculina ringens*, &c. Speaking generally, the Foraminifera are closely allied to those

from Sutton, zone **f**. *Spirillina vivipara*, usually a rare species, is somewhat common here.

Zone **g**.—The most striking feature of this zone is the comparative abundance of *Lagenæ*, particularly the marginate forms. Other rather common species are *Nonionina scapha*, *Spirillina vivipara*, *Miliolina oblonga*, *Planorbulina mediterranensis*, *Textilaria sagittula*, *Bolivina Ænariensis*, and *Rotalia Beccarii*.

Zone **h**.—This has not been examined for Foraminifera, as it is in all probability part of zone **g** reconstructed.

7. Aldborough.—Zone **g**. The pits near the Red House, Leiston Road, close to Aldborough, show about eight feet of fine buff-coloured rubbly limestone full of Bryozoa, in part decalcified. Mollusca are not abundant, those species of which the tests are formed of aragonite having been removed by percolation of carbonated waters. *Chlamys opercularis* is abundant, however, as the shell consists of calcite.[1] Owing to this decalcification Foraminifera are somewhat scarce in this locality, only a few much decomposed Porcellaneous forms, such as *Miliolina oblonga*, *M. seminulum*, and *Biloculina ringens* occurring. The Hyaline forms, although better preserved, are usually in a somewhat decomposed condition, with the chambering obscured. The list, therefore, in all probability by no means represents the Foraminiferal fauna as originally existing.

8. Sudbourne.—Zone **g**. Pits to the north of Sudbourne Church.

The upper beds in this neighbourhood, nearly all referable to this zone, are highly ferruginous, and prove to be very poor in Foraminifera. Certain species are numerically plentiful, but all are difficult to determine, being coated with oxide of iron in such a manner as to render the chambers and sutures indistinct. The following is a complete list of species found after a long search :

1. *Polymorphina gibba*, m. R.
2. *Globigerina bulloides*, m. RC.
3. *Planorbulina mediterranensis*, m. R.
4. *Truncatulina Ungeriana*, s. RC.
5. — *lobatula*, m. VC.
6. — *variabilis*, m. VR.
7. *Pulvinulina repanda*, m. R.

[1] For an account of the experimental evidence obtained as to the cause of the inferior stability of aragonite fossils as compared with those formed of calcite, with special reference to the Foraminifera and Mollusca, see "On the Mineralogical Constitution of Calcareous Organisms," by V. Cornish and P. F. Kendall, 'Geol. Mag.,' new series, dec. 3, vol. v, 1888, pp. 66—73.

8. *Rotalia Beccarii*, s. R.
9. — *calcar*, m. RC.
10. *Polystomella crispa*, m. VC.
11. *Nonionina scapha*, m. VR.

LENHAM BEDS.—The sands and fossiliferous ironstone found at Lenham, in Kent, were referred by Prof. Prestwich[1] to the Crag. Later writers were inclined to consider the beds as of Eocene age ; but a careful re-examination and comparison of the fossils found in this ferruginous sandstone with those of Diestian age have led Mr. C. Reid to fully endorse the view that they are Pliocene; and he states,[2] "As the age of the deposits still seemed very uncertain, it was necessary, for the purpose of this Memoir, to re-examine the ironstones capping the Downs between Folkestone and Maidstone. The result of this examination was thoroughly to confirm Prof. Prestwich's view of the Pliocene age of the beds near Lenham."

The sand does not appear to have been examined for Foraminifera, and, as it has been entirely decalcified, it would probably give but a false conception of the protozoan life. The original scope of this Monograph, also, only extended to the consideration of the Foraminifera of the Crag deposits of the Eastern Counties; but all the English Pliocene beds have been here briefly touched upon to render the work as complete as possible.

THE NODULE-BEDS.—The nodule-beds have already been referred to in dealing with the sections at Sutton, where the zone **a** was originally exposed. Owing to the mixed and *remanié* character of the deposit in the exposures now open, such as Foxhall, no examination has been made for Foraminifera, as the inferences to be drawn from such as might be found, although interesting, might prove misleading.

[1] "On the Age of some Sands and Iron-sandstones on the North Downs," 'Quart. Journ. Geol. Soc.,' vol. xiv, 1858, pp. 322–3.

[2] "Pliocene Deposits of Britain," 'Mem. Geol. Surv.,' 1890, p. 44.

III. DESCRIPTION OF THE SPECIES.

I. PORCELLANEA *vel* IMPERFORATA.

General Characters.—Shells calcareous, imperforate, compact, and porcellaneous in structure; translucent and, when viewed by transmitted light, of a light brown colour.

Family 1.—MILIOLIDÆ.

General Characters.—Shell-structure as above, or sometimes sandy, chitinous, or even siliceous.

Sub-family 1.—MILIOLININÆ.

General Characters.—Chambers two in each convolution, coiled on the long axis of the shell, either symmetrically on one plane or inequilaterally; so that two, three, five, or rarely more are visible externally. Aperture alternately at either end of the shell.

Of late years much earnest research has resulted in our having a better knowledge of this Agathistegian group.

In 1826, when revising the work of previous authors, Alcide D. d'Orbigny ('Ann. Sci. Nat.,' vol. vii, pp. 297—304) placed various forms which had been included by earlier observers in the generic terms *Miliola*, *Miliolites*, *Serpula*, *Vermiculum*, and *Lagena*, into six genera, which he called *Biloculina*, *Spiroloculina*, *Triloculina*, *Articulina*, *Quinqueloculina*, and *Adelosina*, concluding that the definite external segmentation of the test was of real generic importance.

In 1858, W. C. Williamson, in his 'Recent Foraminifera of Great Britain' (Ray Society), united three of the genera (*Triloculina*, *Quinqueloculina*, and *Adelosina*) under the one (new) name *Miliolina*. His chief ground for this amalgamation may be given in his own words:—"This genus differs from *Biloculina* and *Spiroloculina* in the circumstance that the convolutions, instead of being wound in one plane, continually alter their direction." At the same time he

pointed out that the chambers, whatever their convolutions, always retain a parallelism with the polar axis of the test; also "that all the characteristic features of these genera frequently occur in one and the same species;" nor did he consider a definite number of segments to be an essential feature in this consolidated genus (*Miliolina*).

In 1860, "*Miliola*" was used by Parker and Jones as a comprehensive generic term ('Ann. Mag. Nat. Hist.,' ser. 3, vol. v, p. 469); but, as Dr. H. B. Brady has explained ('Challenger' Report, 1884, pp. 137, 156, &c.), it is advisable to retain *Biloculina*, *Fabularia*, and *Spiroloculina* as separate genera, and to keep *Triloculina*, *Quinqueloculina*, and *Adelosina* grouped together under the name *Miliolina* given by Williamson. These four genera constitute the sub-family *Miliolininæ;* the other sub-families—*Nubecularinæ*, *Hauerininæ*, *Peneroplidinæ*, *Alveolininæ*, and *Keramosphærinæ*—completing the family *Miliolidæ*.

MM. Munier-Chalmas and C. Schlumberger, in their researches on the existence of two conditions of growth in many species of Foraminifera, as first indicated for Nummulites by Parker and Jones ('Ann. Mag. Nat. Hist.,' ser. 3, vol. viii, 1861, p. 233, and 'Catal. Foss. Foram. Brit. Mus.,' 1882, p. 93), also for Orbitoides ('Geol. Mag.,' vol. i, 1864, p. 103); and more fully studied by Ph. De la Harpe (see letter dated October 1st, 1879, 'Catal. Foss. Foram. Brit. Mus.,' 1882, pp. 91—93, and 'Mém. Soc. Pal. Suisse,' vol. vii, 1880–8, p. 63, &c.), discovered that such "twin forms," "couples," or "dimorphs" occur in other genera besides Nummulites.[1] These forms were classed in two groups; the one (A) with a large initial chamber (*megalosphere*), and the other (B) with a small initial chamber (*microsphere*).

Among the "*Miliolidæ*" they separated and defined, by means of carefully prepared internal sections, showing the relative size of the primordial chamber, and the arrangement and character of the segments of the test, the following forms:—*Biloculina*, *Dillina*, *Fabularia*, *Lacazina*, *Triloculina*, *Trillina*, *Quinqueloculina*, *Pentellina*, and *Heterillina*. Subsequently[2] *Idalina*, *Adelosina*, *Periloculina*, *Massilina*, *Spiroloculina*, and *Sigmoïlina;* besides others, as *Nodosaria*, *Dentalina*, *Cristellaria*, *Siphogenerina*, *Orbulina*, *Rotalina*, and *Amphistegina* (see E. Vanden Broeck, 'Bull. Soc. Belge Géol. Paléont. Hydrolog.,' vol. vii, 1893, pp. 6—41).

In 1884, H. B. Brady (in the 'Challenger' Report, pp. viii and ix) gave a

[1] 'Bull. Soc. Géol. France,' ser. 3, vol. viii, 1880, p. 300; 'Comptes Rendus,' vol. xcvi, 1883, pp. 862—866, and pp. 1598—1601; 'Ann. and Mag. Nat. Hist.,' ser. 3, vol. xi, 1883, pp. 340, 341.

[2] 'Assoc. Franç. Congrès Rochelle,' 1883, pp. 230—232; 'Congrès Rouen,' 1884, pp. 520—527; 'Bull. Soc. Géol. France,' ser. 3, vol. xii, 1884, pp. 629, 630; vol. xiii, 1885, pp. 273—323; vol. xv, 1887, pp. 573—584; 'Bull. Soc. Zool. France,' vol. xi, 1886, pp. 544—557; 'Mém. Soc. Zool. France,' vol. iv, 1891, pp. 542—578; vol. vi, 1893, pp. 57—80.

succinct account of dimorphism in the two different senses in which it had been applied by Rhizopodists from the time of d'Orbigny to that of Munier-Chalmas and Schlumberger.

The structural differences, among the *Miliolidæ* and others, discovered and illustrated by MM. Munier-Chalmas and Schlumberger are of very great interest, adding much to our knowledge of Foraminifera. They are often associated with external features sufficiently recognisable for the use of the trivial names already in vogue, and the zoological standing of the members of the group is not interfered with. Indeed, their mutual relationships have strong evidence in the new observations. Thus the structure of *Biloculina depressa,* form B, shows that this form passes through (1) a biloculine, (2) a triloculine, (3) a quinqueloculine, and (4) a biloculine stage in reaching completion; whilst *B. comata* has (1) a biloculine, (2) a quinqueloculine, (3) a quadriloculine, (4) a triloculine, and ultimately (5) a biloculine stage. *Adelosina,* after its unilocular form, has biloculine, triloculine, quadriloculine, and quinqueloculine stages. This is termed "initial polymorphism" by MM. M.-Chalmas and Schlumberger. Not only is the real generic value of *Miliolina* thus more firmly established, but it has a right to include *Biloculina* and *Spiroloculina* (as applied by Dr. A. Goës).[1]

M. Schlumberger states that in the *Biloculinæ* and *Triloculinæ* having a small initial chamber (the form B) the first chambers are as in *Quinqueloculina;* subsequent chambers take the arrangement that they have in the other form (A) of each of the two genera, namely, on two planes or surfaces of symmetry for *Biloculina,* and on three for *Triloculina.* He observes ('Bullet. Soc. Zool. France,' vol. xi, 1886, p. 557), "In the three species of *Adelosina* under notice, and in the three groups of *Biloculinæ* already mentioned, the form B presents a special character common to all the individuals of each of the groups. In the *Adelosinæ* this is a megasphere completely enveloped by the first chamber, which becomes lenticular. In the *Biloculinæ* it is the megasphere with two series of chambers on two planes of symmetry. I could cite also the *Triloculinæ* and the *Quinqueloculinæ,* in which the megasphere is encircled with three or with five series of chambers.

"In the form B of these four genera, on the contrary, the microsphere is always encircled with a cycle of five chambers; and this grouping is sometimes regularly or irregularly persistent, and sometimes it is differently arranged.

"I conclude, then, that, in the classification of the *Miliolidæ,* a megaspheric form (A) will determine the genus, and the microspheric (B) the species." He also mentions that many of the *Quinqueloculinæ* are of the genus *Adelosina.*

The thickening of the shell-walls in various degrees, forming labyrinthic interiors and cribriform apertures, already noticed in *Miliolidæ,* as in *Lituolidæ* and

[1] 'K. Svenska Vet.-Akad. Handl.,' vol. xix, No. 4, 1882, pp. 122—132.

other Foraminifera, has been further illustrated by MM. Munier-Chalmas and Schlumberger, whether it be formed by the outside of the chamber last invested or by a subsidiary shell-growth.

As the recognition of the separate species and varieties is, for general purposes, based on the external features of the test, and these are liable to a wide range of variability in individual growths, there is little need of altering the names as given in Part I of this Monograph, except with regard to *Triloculina* and *Quinqueloculina* (pp. 7—14), the necessity for which change the synonymy of *Miliolina oblonga* (pp. 7 and 8) sufficiently supports in the direction of the views above referred to.

The special biological value of the presence of either a *large* (A) or a *small* (B) initial chamber in any Foraminifer has been a chief subject of study by De la Harpe and other observers above mentioned, but definite results have not yet been arrived at.

Those Nummulites grouped under A are generally "free-growing individuals, soon arriving at their limit of growth" (P. and J., 1861); whereas the others (B) attain a larger relative size. This variation in the individuals of one species M. Munier-Chalmas at first (1880) termed "dimorphism," with a different application from that of *Dimorphina* (d'Orbigny, 1846), and "dimorphous" (P. and J., 1860), and "trimorphism" (P. and J., 1863), which have reference to successive stages from one style of growth to another. The later expositions, however, by Munier-Chalmas and his colleague of the growth of the *Miliolidæ* (as noticed above) may be said to give the term its full meaning as to the passage-forms in individuals altering their plan of growth, without reference to the primordial chamber. As the dimorphous forms of *Miliolina*, *Peneroplis*, *Lituola*, *Textilaria*, *Valvulina*, *Polymorphina*, and some of the *Nodosarinæ*, &c., though severally grouped under "generic" names,[1] are plainly referable to their zoological type-forms, so the *Miliolidæ* and allied groups still hold their suzerainty over the more or less differentiated forms, whether species, sub-species, or varieties, elucidated of late by the careful diagnoses elaborated by our esteemed fellow-workers in France (see a note on "Dimorphism" in the 'Annals and Mag. Nat. Hist. Soc.,' Ser. 6, vol. xiv, 1894, pages 401—407).

There is, of course, great difficulty in deciding the relative value of differences among individuals (of all the groups) showing modifications (often inconsiderable) or deviations from the zoological type, whether due to idiosyncrasy of the individual or to evolution among the many, for they may have been caused by accidents of

[1] Such as *Articulina, Spirolina, Haplophragmium, Bigenerina, Spiroplecta, Gaudryina, Clavulina, Amphicoryne, Flabellina, Marginulina, Dimorphina, Sagrina,* &c.

growth, or they may show ontogenetic variation, due to progression, or even to deterioration of the special form.

Although Foraminifera, like other organisms, should be classified on true morphological characters, we all know it is good that the differences of individual forms, and of limited groups of such varieties, should be carefully noted and made serviceable to collectors and systematists; and the only acceptable plan for the purpose is (as has often been said) to apply the usual nomenclatorial terms, without regarding them as of the same value as when applied to members of the groups of higher animals. Keeping this in mind, we are glad to use the results of the judicious and discriminative labours of MM. Munier-Chalmas and C. Schlumberger, as in the case of earlier rhizopodal workers, and to give full references to their descriptions and figures whenever fit opportunities occur.

Clear and important remarks on this subject have been given by Dr. A. Goës in the 'K. Svenska Vet.-Akad. Handl.,' vol. xix, No. 4, p. 7; and vol. xxv, No. 9, p. 5.

Genus 1.—Biloculina, *d'Orbigny*, 1826.

Part I, 1866, page 4. Brady's Report 'Challenger,' 1884, p. 139.

Characters.—Chambers in one plane, embracing; the last two only visible.

We need not enlarge on the exact and philosophical treatment of this Foraminiferal type by Williamson (1858) and Brady (1884), nor repeat the general remarks published at pp. 4—6 of Part I. *Biloculina* multiplies itself in extremely variable and gradational forms; two of its most recognisable features are (1) the slit-like aperture of *B. ringens*, and (2) the more contracted and somewhat projecting aperture of *B. bulloides*.[1] The shape of the test varies from subglobose, with two faces of varying inequality, to disciform or oval (thick or thin), long-oval or subcylindric, &c., each shape claiming a separate name with many authors. On the external sculpturing and other ornaments, and sometimes on the constitution and consistency of the test, other names are based.

Of late the internal structure, so well studied by MM. Munier-Chalmas and Schlumberger, has enabled them to recognise a greater fixedness in some of the structural characters; indeed, these observers have been able to systematise as tangible species (if not genera) some forms regarded as varieties; at the same time we feel confident in relegating many of the "species," formerly so called, to mere varieties of a type or sub-type.

In the 'Svenska Vet.-Akad. Handl.,' vol. xix, 1882, pp. 131—134, Goës offers a

[1] See further on, p. 21.

classification of *Biloculinæ* founded on the external shapes, with illustrations in plate x; see also op. cit., vol. xxv, 1894, pp. 116—121.

In treating of *Biloculina bulloides* and *B. ringens* ('Bull. Soc. Géol. France,' 1887, p. 579, M. Schlumberger states that, from the study of the *Miliolidæ* by Signor Fornasini and himself, it is found that the Pliocene forms are much nearer to the existing forms than to those from the Eocene strata.

1. Biloculina ringens (*Lamarck*), 1804. Plate III, figs. 26, 27.

Part I, 1866, page 5; and Appendix II, Table, No. 3.

Some of the more important of later synonyms of *B. ringens* are—

Biloculina ringens, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 5, pl. iii, figs. 26, 27.
— antiqua, *Karrer*, 1867. Sitzungsb. Akad. Wiss. Wien, vol. lv, p. 365, pl. iii, fig. 7 (Jurassic).
— bulloides, var. calostoma, *Karrer*, 1868. Ibid., vol. lviii, p. 132, pl. i, fig. 4.
— anodonta, *Karrer*, 1868. Ibid., p. 133, pl. i, fig. 6.
— turgida, *Reuss*, 1870. Ibid., vol. lxii, p. 464; *Schlicht*, Pietzpuhl, 1870, pl. xxxv, figs. 27—29; and pl. xxxvi, figs. 1—3.
— caudata, *Reuss*, 1870. Ibid., vol. lxii, p. 464; *Schlicht*, Pietzpuhl, 1870, pls. xxxv, figs. 33—38.
— ringens (and varieties?), *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, p. 152, pl. xxiii, figs. 32—36.
Miliolina ringens, *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, p. 131, pl. x, figs. 361, 362.
Biloculina ringens, *Brady*, 1884. Rept. 'Challenger,' p. 142 (with synonymy), pl. ii, figs. 7 and 8. (Brady's fig. 7 is Schlumberger's "*B. Bradyi*," and fig. 8 his "*B. vespertilio*," 1891, pl. ix, figs. 63—71, and 74—76.)
— — var., *Balkwill and Wright*, 1885. Trans. Roy. Irish Acad., vol. xxviii, p. 322, pl. xii, figs. 6, 7.
— — *Dawson*, 1886. Handbook of Zoology, p. 45, fig. 36.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 219.
— intermedia, *Fornasini*, 1886. Ibid., vol. v, p. 259, pl. iv, fig. 2; and pl. v, fig. 2.
— brachyodonta, *Fornasini*, 1886. Ibid., vol. v, p. 260, pl. iv, fig. 3; and pl. v, fig. 3.
— ringens, *Schlumberger*, 1887. Bull. Soc. Géol. Fr., ser. 3, vol. xv, p. 126, pl. xv, figs. 14—18; and woodcuts, figs. 6—9.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc. Lond., vol. xii, p. 213, pl. xl, figs. 19, 20.

MILIOLINA RINGENS, *Goës*, 1889. Bihang k. Svensk. Akad. Handl., vol. xv, part 4, No. 2, p. 14, pl. ii, figs. 7, 13, and 14.
BILOCULINA RINGENS, *Terrigi*, 1889. Atti R. Acc. Lincei Mem., ser. 4, vol. vi, p. 107, pl. iv, fig. 1.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 220, pl. i, figs. 7—9.
— INTERMEDIA, *Fornasini*, 1893. Mem. R. Accad. Bologna, ser. 5, vol. iii, p. 440, pl. i, figs. 1, 1 *a*.

(NOTE.—In the reference to P. and J., 1857, in the synonymy given at p. 5 of Part I, figs. 32 and 33 should be omitted, being probably striated forms of *B. bulloides*.)

The aperture usually consists of a transverse slit, but varies in relative size and in the shape of the tongue-like valve, not only in those mentioned in the synonymy, but also in others, among which are several that have received from M. Schlumberger the specific names of *Bradyi* (*ringens*, Rep. 'Challenger,' p. 142, pl. ii, fig. 7), *vespertilio* (*ringens*, ibid., fig. 8), *Fischeri*, *Milne-Edwardsi*, *pisum*, *anomala?*), in 'Mém. Soc. Zool. France,' vol. iv, pp. 166—182, pls. ix—xi, figs. 55, &c., and woodcuts. The *B. ringens*, Schlumb., 'Bull. Soc. Géol. France,' ser. 3, vol. xv, pl. xv, figs. 14—18, have subcircular apertures.

Goës unites with the typical *Biloculina* (*Miliolina*) *ringens* (figs. 7, 13, and 14, pl. ii, 'Bihang k. Svensk. Vet.-Ak. Handl.,' vol. xvi, part iv, No. 2) several varieties of triloculine growth.

Taking a group of *Biloculinæ* belonging to *B. ringens* as far as the transverse slit-like mouth is concerned (for example, some figured in d'Orbigny's 'Foram. Foss. Vienne,' 1846), we may notice that they vary from lenticular to subrotund and subovate, thus:

1. Lenticular, *B. lunula*, p. 264, pl. xv, figs. 22—24 [*B. depressa*].
2. Sublenticular, *B. affinis*, p. 265, pl. xvi, figs. 1—3.
3. Subrotund, *B. simplex*, p. 264, pl. xv, figs. 25—27.
4. Subovate, *B. clypeata*, p. 263, pl. xv, figs. 19—21.
5. Subpyriform, *B. inornata*, p. 266, pl. xvi, figs. 7—9.

The last (No. 5) has a contracted, subcircular, and slightly projecting aperture, thus approaching *B. bulloides*, with which we group it now as a variety.

An interesting group of *Biloculinæ* were figured (but not named nor described) by Dr. G. C. Wallich in 1862, "The North Atlantic Sea-bed," part i, pl. v, namely, fig. 1, *Biloculina ringens*; figs. 2, 5, and 8, *B. depressa*; figs. 3, 4, and 6, *B. bulloides*. They escaped notice in Part 1 of this Monograph, 1866, but are well worthy of attention. See also a group of *B. ringens* and varieties in Schlicht's 'Foram. Septar.-Thones Pietzpuhl,' 1870, pl. xxxv, figs. 27—29, 33—

35, 36—38, and pl. xxxvi, figs. 1—3, variously named by Reuss in the 'Sitzungsb. k. Ak. Wiss. Wien,' vol. lxii, 1870, page 464.

Another group, having its most globose form with a transverse aperture in a somewhat projecting mouth, passes into forms with more contracted aperture, thus resembling *B. inornata*, d'Orb., in the rounded and projecting aperture. These are shown in—

Biloculina bulloides, *d'Orb.*, var. truncata, *Reuss*, 1867. Sitzungsb. k. Akad. Wiss. Wien, vol. lv, p. 69, pl. ii, fig. 1.
— — — var. truncata-gracilis, *Reuss*. Ibid., fig. 2.
— larvata, *Reuss*, 1867. Ibid., vol. lv, p. 70, pl. ii, fig. 3. With this last form the following nearly corresponds:
— tenuis, *Karrer*, 1868. Ibid., vol. lviii, p. 133, pl. i, fig. 5.

As examples of differences we may remark that in pl. xv, 'Bull. Soc. Géol. France,' 1887, M. Schlumberger gives *B. ringens* (from the Paris Tertiaries) with a subcircular aperture, and *B. bulloides* (from Grignon) with a low subcircular aperture and a simply forked tongue.

Occurrence.—*Biloculina ringens* is common in every sea, and at all depths to nearly 3000 fathoms. It occurs in the Upper Jurassic (Karrer), and the Eocene of the Paris Basin. It is common in Tertiary formations generally. In the Coralline Crag of Sutton the species is not uncommon, and it occurs rarely in other exposures of the same formation and in the Red Crag.

2. Biloculina elongata, *d'Orbigny*, 1826. Plate III, fig. 28 (end view shows the aperture), and Plate VI, figs. 1 *a*, *b*. Part I, 1866, page 5, footnote.

Biloculina elongata, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 298.
Miliola (Biloculina) elongata, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. xvii, fig. 88 (not 90 and 91 = another var. of *B. bulloides*).
Biloculina elongata, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 247, pl. viii, fig. 6.
— — *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, p. 154, pl. xvi (xxiv), fig. 1.
— — *Brady*, 1884. Report 'Challenger,' p. 144, pl. ii, fig. 9 (synonymy).
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 218 (with synonymy) and 271.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 214, pl. xl, figs. 21, 22.
Miliolina elongata, *Goës*, 1889. Bihang k. Svensk. Vet.-Akad. Handl., vol. xv, part 4, No. 2, p. 14, pl. ii, fig. 12.

BILOCULINA ELONGATA, *Schlumberger*, 1891. Mém. Soc. Zool. France, vol. iv, p. 571, cuts 35, 36, pl. xi, figs. 87, 88; pl. xii, fig. 89. (Figs. 87—89 make a near approach to d'Orbigny's *B. inornata*, figs. 7—9, pl. xvi, For. Foss. Vien.)
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3,
— — pp. 308, 468, 469.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abtheil. ii, p. 220, pl. i, fig. 1.
— — *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 119, pl. xxiv, figs. 906—913.

Characters.—*Biloculina elongata* may be grouped with *B. ringens* as a narrow or contracted variety, subcylindrical or elongate-oval in shape, with its aperture more or less subcircular, and a somewhat modified epistomium.

Occurrence.—This form has a wide geographical distribution. It appears to be more common in the North Atlantic and South Pacific. In a fossil condition it has been recorded from the Eocene of Paris (Terquem), from the Miocene (?) of Muddy Creek, Victoria (Howchin), and from the Plaisancian (Older Pliocene) of Castellarquato. This species was recorded before only from the Red Crag; we now find it rarely, but of large size, in the pits of the Coralline Crag at Sudbourne Hall and Broom Hill, both in Zone **d**.

The following list is a classification of *Biloculina elongata* and its immediate allies, drawn up with great care, and kindly supplied by F. W. Millett, Esq., F.R.M.S.

I. BILOCULINA ELONGATA with exposed portion of penultimate chamber not pyriform.

Frumentaria *Ovula*, *Soldani*, 1795. Testaceograph. vol. i, part 3, p. 228, pl. cliii, figs. M and Q.
BILOCULINA SACCULUS, *Terquem*, 1858. Mém. Ac. Imp. Metz, vol. xxxix, p. 636, pl. iv, fig. 15.
— RINGENS, *Terquem*, 1876. Foram. Dunkerque, p. 80, pl. x, fig. 21.
— ELONGATA, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 154, pl. xxiv, fig. 1 (near *bulloides*).
— — *Brady*, 1884. Rept. 'Challenger,' p. 144, pl. ii, fig. 9.
— — *Goës*, 1894. K. Svensk. Ak. Handl., vol. xxv, p. 119, pl. xxiv, figs. 910, 911.

II. Biloculina elongata with exposed portion of penultimate chamber pyriform.

Frumentaria *milium*, *Soldani*, 1795. Testaceograph. vol. i, part 3, p. 231, pl. clvi, fig. *vv*.
Biloculina opposita, *Deshayes*, 1831. Descr. Coq. Caract., p. 259, pl. iii, figs. 8—10.
— Bougainvillei, *d'Orbigny*, 1839. Foram. Amérique Mérid., p. 67, pl. viii, figs. 22—24.
— Patagonica, *d'Orbigny*. Ibid., p. 65, pl. iii, figs. 15, 17.
— oblonga, *d'Orbigny*, 1839. Foram. Cuba, p. 163, pl. viii, figs. 21—23.
— inornata, *d'Orbigny*, 1846. Foram. Foss. Vien., p. 266, pl. xvi, figs. 7—9.
— appendiculata, *Eichwald*. Leth. Ross., p. 11, pl. i, fig. 12 (near *inornata*).
— ringens, var. Patagonica, *Williamson*, 1857. Rec. For. Brit., p. 80, pl. vii, figs. 175, 176.
— elongata, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. xvii, figs. 90, 91.
— bulloides, var. truncato-gracilis, *Reuss*, 1867. Sitz. Akad. Wiss. Wien, vol. lv, Abth. 1, p. 68, pl. ii, fig. 2.
— larvata, *Reuss*, 1867. Ibid., p. 70, pl. ii, fig. 3.
— tenuis, *Karrer*, 1868. Ibid., vol. lviii, Abth. 1, p. 133, pl. i, fig. 5.
— ringens, *Chimmo*, 1870. Bed of the Atlantic, p. 27, pl. x, fig. *a*.
— (indet.), *Chimmo*, 1878. Nat. Hist. Euplectella, pl. vi, fig. 21.
— elongata, *Fornasini*, 1891. For. Plioc. Ponticello, pl. ii, fig. 2.
— — *Schlumberger*, 1891. Mém. Soc. Zool. Fr., vol. iv, p. 184, pl. xi, figs. 87, 88; and pl. xii, fig. 89, and figs. 35, 36, p. 184.

III. Other Biloculinæ with the exposed portion of penultimate chamber pyriform.

Near *sphæra*.

Biloculina Grinzingensis, *Karrer*, 1877. Abhandl. k.-k. geol. Reichs., vol. ix, p. 375, pl. 16*a*, fig. 8.

Near *irregularis*.

Biloculina ventruosa, *Reuss*, 1867. Sitz. k. Ak. Wiss. Wien, vol. lv, Abth. 1, p. 69, pl. i, fig. 9.

Between *depressa* and *ringens*.

Biloculina Isabelleana, *d'Orb.*, 1839. Foram. Amériq. Mérid., p. 66, pl. viii, figs. 17—19.

Between *bulloides* and *ringens.*

BILOCULINA LÆVIS, *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 119, pl. xxiv, figs. 914, 915.

Near *ringens.*

BILOCULINA BULLOIDES, var. TRUNCATA, *Reuss*, 1867. Sitz. k. Ak. Wiss. Wien, vol. lv, Abth. 1, p. 68, pl. ii, fig. 1.
— cf. ELONGATA, *Fornasini*, 1891. For. plioc. Ponticello, pl. ii, fig. 1.

Near *bulloides.*

BILOCULINA PERUVIANA, *d'Orb.*, 1839. Foram. Amériq. Mérid., p. 68, pl. ix, figs. 1—3.
— CONSTRICTA, *Costa*, 1856. Atti Accad. Pont., vol. vii, fasc. 2, p. 301, pl. xxiv, fig. 2.
— LIASICA, *Zwingli and Kubler*, 1870. Foram. Schweiz. Jura, p. 7, pl. i, Turnerithon, fig. 18.
— RINGENS, *G. M. Dawson*, 1870. Canadian Naturalist, n. s., vol. v, p. 8, fig. 8.
— BULLOIDES, *Brady*, 1884. 'Challenger' Rept., p. 142, pl. ii, fig. 5.
— TUBULOSA, *Brady*, 1884. Ibid., p. 147, pl. iii, fig. 6.
— LARVATA, var. VENTRICOSA, *Mariani*, 1888. Atti Soc. Ital. Sci., vol. xxxi, p. 94, pl. xxxi, fig. 1.

MILIOLINA RINGENS, *Goës*, 1889. Bihang k. Svensk. Vet.-Ak. Handl., vol. xx, part 4, No. 2, p. 14, pl. ii, fig. 10.

BILOCULINA ELONGATA, *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 119, pl. xxiv, figs. 910, 911.

3. BILOCULINA DEPRESSA, *d'Orbigny*, 1826. Plate III, figs. 29, 30, and Pl. V, fig. 1.

Part I, 1866, page 6; and Appendix II, Table, No. 5.

Additional Synonyms :

BILOCULINA DEPRESSA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 298 ; Modèle, 91.

MILIOLA (BILOCULINA) DEPRESSA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. xvii, fig. 89.

BILOCULINA DEPRESSA, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 33, pl. i, fig. 4.
— — *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 6, pl. iii, figs. 29, 30.
— SCUTELLA, *Karrer*, 1868. Sitzungsb. k. Akad. Wiss. Wien, vol. lviii, p. 134, pl. i, fig. 7.
— DEPRESSA, *Karrer*, 1877. Abhandl. k. k. Geol. Reichst., vol. ix, p. 374, pl. 16*a*, fig. 7.

BILOCULINA DEPRESSA, *Munier-Chalmas and Schlumberger*, 1883. Compt. Rend., vol. xcvi, p. 864, figs. 1 and 2; and Ann. Mag. Nat. Hist., ser. 5, vol. xi, p. 338, figs. 1 and 2; and 1885, Bull. Soc. Géol. France, ser. 3, vol. xiii, pp. 278, 280, figs. 4, 5, and 5 bis.

— — *Schlumberger*, 1884. Assoc. Sci. France, Congrès Rouen, 1883, pp. 522—525, figs. 3—8.

— — *Brady*, 1884. Report "Challenger," p. 145 (with synonymy), pl. ii, figs. 12, 15—17; pl. iii, figs. 1, 2 (Brady's fig. 15 is Fornasini's "*B. Bradyi*," Boll. Soc. Geol. Ital., vol. v, 1886, p. 261).

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 261.

— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 213, pl. xl, figs. 17, 18.

MILIOLINA DEPRESSA, *Goës*, 1889. Bihang k. Svensk. Vet.-Akad. Handl., vol. xv, part 4, No. 2, p. 14, pl. ii, figs. 15, 16.

BILOCULINA DEPRESSA, *Schlumberger*, 1891. Mém. Soc. Zool. France, vol. iv, p. 547, cuts 1—5, pl. ix, figs. 48, 49.

— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, abth. 2, p. 220, pl. i, figs. 4—6.

— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 17, 178, 179, 307.

— — *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 120, pl. xxv, figs. 921—925.

Characters.—This is essentially a depressed variety of *B. ringens*, having its opposite faces much less convex than in the type. The chambers become flattened at the edge into a keel, which is often exaggerated into a broad, thin lamina,[1] sometimes crenulate.[2]

Some depressed *Biloculinæ* have the aperture somewhat contracted, and in this respect approach *B. bulloides*. Brady's figs. 15 and 16, in pl. ii, Rep. 'Chall.,' show such passage-forms.

Occurrence.—*Biloculina depressa.*—The geographical range of this species is co-extensive with that of *B. ringens*. Geologically it occurs in the Eocene, London Clay and Bracklesham Beds, in the Miocene of Vienna and Muddy Creek, Victoria, in the Diestian and Casterlian of Antwerp, and in the Tertiaries of Malaga and Piedmont. In addition to the occurrence at Sutton recorded in Part I of this Monograph, we find this species, but rarely, at Broom Hill (zone **d**).

[1] As Williamson's *B. ringens*, var. *carinata*, figs. 172—174, p. 79, 'Rec. Br. Foram.,' 1858.

[2] As Goës's *M. ringens*, pl. x, fig. 361, p. 131, 'Svensk. Akad.,' 1882.

Biloculina bulloides, *d'Orbigny*, 1826. Var. inornata, *d'Orb.*, 1846. Plate VII, figs. 1 *a*, *b*, *c*.

Characters.—The specimen under notice appears to be a suboval variety of *B. bulloides*, with a somewhat circular aperture situated in a slightly produced neck; corresponding with—

Biloculina inornata, *d'Orb.*, 1846. Foram. Foss. Bass. Tert. Vienne, p. 266, pl. xvi, figs. 7—9.
— bulloides, var. truncata-gracilis, *Reuss*, 1867. Sitz. k. Akad. Wiss. Wien, vol. lv, p. 69, pl. ii, fig. 2 (named on the plate).
— tenuis ?, *Karrer*, 1868. Ibid., vol. lviii, p. 133, pl. i, fig. 5.

Var. *inornata* is also closely allied to *B. elongata*, for the latter often has the exposed portion of the penultimate chamber pear-shaped; and there are few of those bearing that character that would not be assigned to *elongata*.

To complete the series of typical *Biloculinæ* referred to at page 93, we here add a brief synonymy of *B. bulloides*, d'Orb.

Biloculina bulloides, *Terquem* (after *d'Orbigny*), 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, p. 153, pl. xxiii, fig. 38.
Miliolina ringens, *Goës*, 1882. K. Svenska Akad. Handl., vol. xix, p. 131, pl. x, figs. 363—365, 386 ?.
Biloculina bulloides, *Brady*, 1884. 'Challenger' Rept., p. 142, pl. ii, figs. 5, 6 (= *lucernula*, Schlumb., 1891).
— — *Fritel*, 1886. Foss. Caract. Terr. Séd., pl. 7, figs. 68, 69.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 219 (with synonyms).
— — *idem*, 1886. Ibid., vol. v, p. 257, pl. iv, fig. 1; pl. v, fig. 1.
— — *idem*, 1887. Ibid., vol. vi, fasc. 1, p. 12 (with synonyms).
— — *Schlumberger*, 1887. Bull. Soc. Géol. Fr., sér. 3, vol. xv, pp. 574—579, pl. 15, figs. 10—13, and woodcuts 1—5.
Miliolina ringens, *Goës*, 1889. Bihang till k. Svenska Vet.-Akad. Handl., vol. xv, p. 14, pl. ii, fig. 10.
Biloculina lucernula, *Schlumberger*, 1891. Mém. Soc. Zool. Fr., vol. iv, p. 185, pl. 12, figs. 90—96, and woodcuts figs. 37—41.
— bulloides, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. 2, p. 217, pl. i, figs. 16—18.
— — } and their allies, *Goës*, 1894. K. Svensk. Akad. Handl.,
— ringens, } vol. xxv, No. 9, pp. 116—119.

M. Schlumberger does not admit Signor Fornasini's pl. v, fig. 1 (quoted above), to be a true *B. bulloides* ('Bull. Soc. Géol. France,' 1887, p. 574), on account of some difference of internal structure. In referring (loc. cit.) to the confusion of the species (*B. bulloides* and *B. ringens*), he rightly blames the often indifferent figures and imperfect descriptions given by former writers, as well as the dearth of information about the internal structure. Another reason, however, for this apparent confusion is that the classifications of Foraminifera have been based on the existence of zoological type-forms (whether generic or specific), the other forms having been grouped more or less closely with them. Thus *Biloculina ringens* was taken as one Milioline type, and *M. seminulum* as another by Parker and Jones (1857, 1860, &c.), by Williamson (1858), by Goës (1882), by Brady (1884). Consequently great latitude of opinion has arisen on the subject of the relationship of these almost interminably gradational, and often isomorphous forms. Similarly this holds good to a great extent among the members of the genus *Nodosarina* proposed by Parker and Jones. The differentiation of internal structures, as shown by MM. Munier-Chalmas and Schlumberger, and the researches carried on now-a-days in the life-history of some of the Foraminifera,[1] raise hopes of a better distinction of forms, and of a more perfect classification.

Occurrence.—The typical *Biloculina bulloides* is recorded as common in the North Atlantic, but more rarely in other latitudes; and it has a wide bathymetrical range. It is a common Tertiary fossil. The var. *inornata* has been found in the Miocene of Vienna, the Tertiaries of Piedmont, and the Diestian and Scaldisian of Antwerp. In the Crag we find it, small and very rare, at Sudbourne Hall, Gedgrave, and Sutton.

Genus 2.—Spiroloculina, *d'Orbigny*, 1826.

Part[2] I, 1866, page 15.

D'Orbigny, 'Foram. Foss. Tert. Vienne,' 1846, p. 268; Brady, Report 'Challenger,' 1884, p. 147; Egger, 'Abhandl. k. Bayer. Akad.,' 1893, vol. xxviii, Abth. 2, p. 221.

General Characters.—Chambers opposite, alternate, in one plane; all visible on both sides (faces) of the shell.

For convenience it is found best to arrange the more common *Spiroloculinæ* in six groups according to certain features which are recognisable in different

[1] See also J. J. Lister's "Contributions to the Life-history of the Foraminifera," 'Proc. Roy. Soc.,' vol. lvi, No. 337, 1894, pp. 155—160.

[2] In the last line but one of the synonyms at p. 15 *read* p. 470 *instead of* p. 466.

examples, though subject to modification and interchange. Thus :—1. Those that have the surfaces of the chambers flat (planulate). 2. The surfaces of the chambers sloping down towards the centre of the shell (excavate). 3. The outer margin or periphery channelled, being bordered by two limbate edges (canaliculate). 4. The chambers bordered by raised lines or ridges (limbate). 5. Chambers convex on surface (rotundate). 6 & 7. Other forms, not here dealt with, either (6) have the surfaces of their chambers raised and ridged (angulate); or (7) have them sunken and concave (hollow-chambered).

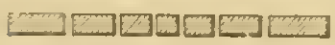
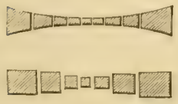
1 

FIG. 1.—*Spiroloculina planulata* (Lam.). Diagram representing a transverse section of the flat whorls of the shell.

2a, 2b 

FIGS. 2 *a*, 2 *b*.—*Spiroloculina excavata*, d'Orb. Diagrams showing the surfaces of the whorls (*a*) sloping inwards on each surface to the hollow centre of the shell; and (*b*) sinking by steps into the hollow of the centre.

3a, 3b 

FIGS. 3 *a*, 3 *b*.—*Spiroloculina canaliculata*, d'Orb. Diagrams showing the concave (channelled) outer margin of the whorls; in Fig. 3 *b* the surface-margins of the chambers are somewhat limbate.

4 

FIG. 4.—*Spiroloculina dorsata*, Reuss. Diagram of a transverse section of the whorls with superficial shell-growth at the outer margin of each whorl, marking the sutures of each face.

5 

FIG. 5.—*Spiroloculina nitida*, d'Orb. Diagram showing the convex surfaces of the whorls.

6 

FIG. 6.—*Spiroloculina*, section of, with whorls having an angular surface.

7 

FIG. 7.—*Spiroloculina*, section of, with the whorls concave on the exterior surfaces.

1. SPIROLOCULINA PLANULATA (*Lamarck*), 1804. Pl. III, figs. 37, 38; Woodcut, fig. 1. Part I, 1866, page 15; and Appendix II, Table No. 15.

MILIOLITES PLANULATA, *Lamarck*, 1804. Ann. Mus., vol. v, p. 352; 1822, Anim. sans Vert., vol. vii, p. 612 (three varieties are indicated by Lamarck).

SPIROLOCULINA DEPRESSA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 298, No. 1; Modèle, No. 92; Parker, Jones, and Brady, 1865, Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 33, pl. i, fig. 6; and ser. 4, vol. viii, 1871, p. 248, pl. viii, fig. 23; referred to *Sp. planulata.*

— PERFORATA, *Bronn*, 1838. Lethæa Geognostica, p. 1143, pl. xlii, fig. 33.

— BADENENSIS, *d'Orbigny*, 1846. Foram. Foss. Vien., p. 270, pl. xvi, figs. 13—15.

— DILATATA, *d'Orbigny*, 1846. Ibid., p. 271, pl. xvi, figs. 16—18.

SPIROLOCULINA SANDBERGERI, *Reuss*, 1853. Neues Jahrb. für Min., p. 671, pl. ix, fig. 2 (rather concave in the middle).
— PLANULATA, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. v, p. 470.
— EXCAVATA, *Brady*, 1865. Nat. Hist. Trans. Northumb. and Durham, vol. i, p. 93, pl. xii, fig. 1.
MILIOLA (SPIROLOCULINA) PLANULATA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 408, pl. xvii, fig. 82.
SPIROLOCULINA PLANULATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 15, pl. iii, figs. 37, 38.
— COMPRESSIUSCULA, *Karrer*, 1867. Sitz. k. Akad. Wiss. Wien, vol. lv, p. 258, pl. ii, fig. 4.
— DEPRESSA, *Terquem* (after *d'Orbigny*), 1878. Mém. Soc. Géol. France, sér. 3, vol. i, p. 54, pl. x, fig. 11. This seems to agree with Soldani's figure chosen by d'Orbigny for his "*depressa*" (see Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 33, 1865), but that was already the *planulata* of Lamarck.
— DILATATA, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 133, pl. xvii, fig. 13.
— PLANULATA, *Brady*, 1884. 'Challenger' Rept., p. 148, pl. ix, fig. 11.
— DEPRESSA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 221, No. 295.
— PAPYRACEA, *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Microsc. Soc., vol. for 1890, p. 551, pl. viii, fig. 1 (thin variety).
— ? DEPRESSA,[1] *Schlumberger*, 1893. Mém. Soc. Zool. France, vol. vi, p. 202, pl. iii, fig. 69, and woodcut, fig. 2.
— PLANULATA (?), *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 19, 178, 179.
— cf. PLANULATA, *Idem*, 1893. Ibid., p. 309.

Characters.—Lateral surfaces of the chambers plane and parallel to the axis of the shell; shell sometimes slightly concave; periphery usually flat and square; the surfaces of the chambers are sometimes slightly concave. Lamarck indicated three forms of his *Miliolites planulata*, namely: α, the typical *planulata*; β, less flattened, var. *turgidula*; and γ, thin and keeled, *planissima* (see 'Ann. Mag. Nat. Hist.,' ser. 3, vol. v, 1860, p. 470). The second of these perhaps may have corresponded with the form named by Williamson *Spiroloculina depressa*, var. *rotundata* ('Rec. Brit. For.,' 1858, p. 82, fig. 178), and probably with *Sp. nitida*, d'Orb. ('Ann. Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 248, pl. viii, fig. 24), and *Sp. rotunda*,[2] d'Orb. (ibid., fig. 25), excepting as to the shape of outline. The name

[1] The section given at p. 202 is that of *M. excavata*.

[2] Not *rotundata*, as printed loc. cit.

"*turgidula*" would have been applicable if we knew the specimen, but for those varieties having more or less convex chambers we must take "*nitida*"—d'Orbigny's earliest name. The flat-chambered forms, however, remain as *Sp. planulata*, whether oval or round in outline, and whether square or rounded on the margin or even slightly channelled, as in our Pl. III, figs. 37, 38. They are very liable to vary in relative thickness. Some specimens become somewhat concave by a step-like arrangement of the flat chambers rising one higher than the other during the growth of the shell.

Other varieties of *Sp. planulata* have the surfaces of the chambers slightly concave, such as are well shown in *Sp. Badenensis*, d'Orb., and *Sp. dilatata*, d'Orb. These, moreover, being somewhat concave in the middle, are evidently passage-forms leading to *Sp. excavata*, d'Orb.

The following have the chambers slightly hollowed, the shell, however, remaining flat: *Sp. cretacea*, Reuss, and *Sp. compressiuscula*, Karrer.

Some of the *planulata*-group forms are very thin (such as the *compressiuscula*, K., and *papyracea*, B. S. B.). Of the flat-chambered forms our figs. 37 and 38, in Pl. III, represent an extreme example (with slightly fluted margin), but are well matched in Brady's Report 'Challenger,' pl. ix, fig. 11 (with plane margin).

Occurrence.—As a shallow-water form *Spiroloculina planulata* has a wide geographical range in temperate latitudes. It has been recorded as a fossil from the London Clay, the Calcaire grossier of the Paris basin, the Miocene of Vienna, and the Tertiaries of Palermo. In the Crag it has been found at Sutton only. In the First Part of this Monograph it is stated to occur commonly there; but in our material we have not been able to find a single specimen from Sutton or elsewhere.

Mr. Millett observes that—

SPIROLOCULINÆ having plane chambers with ornamented surfaces are—

SPIROLOCULINA COSTIGERA, *Terquem*, 1882. Mém. Soc. Géol. Fr., sér. 3, vol. ii, p. 159, pl. xxiv, fig. 24.

— PERTUSA, *Terquem*, 1882. Ibid., sér. 3, vol. ii, p. 160, pl. xxiv, fig. 27.

— SEMIORNATA, *Terquem*, 1882. Ibid., sér. 3, vol. ii, p. 161, pl. xxiv, fig. 28.

2. SPIROLOCULINA EXCAVATA, *d'Orbigny*, 1846. Plate V, fig. 2; Woodcuts, figs. 2 *a*, 2 *b*.

SPIROLOCULINA EXCAVATA, *d'Orbigny*, 1846. Foram. Foss. Vienne, p. 271, pl. xvi, figs. 19, 20.
— (not named), *Costa*, 1838. Fauna Regno Napoli, pl. ii, fig. 2.
— EXCAVATA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 311, pl. xxiv, fig. 11.
— DEPRESSA, var. ROTUNDATA, *Williamson*, 1857. Rec. Brit. Fos., p. 82, pl. vii, fig. 178.
— FREYERI, *Reuss*, 1864. Denks. k. Akad. Wiss. Wien, vol. xxiii, p. 6, pl. i, fig. 9.
— EXCAVATA, *Brady*, 1865. Nat. Hist. Trans. Northumb. and Durham, vol. ii, part 1, p. 93, pl. xii, fig. 1.
— CAVERNOSA, *Karrer*, 1867. Sitz. k. Ak. Wiss. Wien, vol. lv, Abth. 1, p. 358, pl. ii, fig. 3.
— EXCAVATA, *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 38, pl. v, fig. 17.
— ANGULOSA, *Terquem* (after *d'Orbigny*), 1878. Mém. Soc. Géol. Fr., sér. 3, vol. i, p. 53, pl. x, fig. 7.
— CRASSA, *Seguenza*, 1880. Mem. R. Accad. Lincei, ser. 3, vol. vi, p. 152, pl. xiv, fig. 10.
— (indet.), *Carpenter*. Introd. Foram., 1862, pl. vi, fig. 1; re-figured in Schlumberger's Feuill. Jeun. Nat. Année xii, 1882, p. 29, pl. ii, fig. 4. Apparently excavate, with slightly concave chambers.
— cf. BICARINATA, *Schwager*, 1883. Palæontographica, vol. xxx, p. 85, pl. i, fig. 4.
— EXCAVATA, *Brady*, 1884. 'Challenger' Rept., p. 151, pl. ix, figs. 5, 6.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 238, No. 368.
— LIMBATA, *Chapman*, 1892. Quart. Journ. Geol. Soc., vol. xlviii, p. 516, pl. xv, fig. 4.
— EXCAVATA, *Egger*, 1893. Abhandl. k. Bayer. Akad., cl. ii, vol. xviii pp. 219, 223, pl. i, figs. 44, 45.
— — *Schlumberger*, 1893. Mém. Soc. Zool. Fr., vol. vi, p. 201, fig. 1; and pl. iii, fig. 68.
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 20, 178, 179, 310.
— SOLDANII, *Fornasini*, 1894. Foram. Coll. Soldani (Sagg. Oritt.), p. 20, pl. o, fig. 1.

Characters.—Lateral surfaces of the chambers plane or hollowed, and inclined to the axis of the shell, either by a uniform slope or by steps, so that it

is sunken in the centre and biconcave; sutures sometimes limbate; edges thick, and the margins plane, or nearly so.

In this form the chambers gradually increase in thickness from the first to the last, so that the inner or central part of the test is hollow and thin, and the outer is thick, with more or less projecting edges.

Our form, Pl. V, fig. 2, is very similar to d'Orbigny's representation of the Vienna fossil. Some specimens are more oval and produced at the ends.

As in other cases, some confusion has arisen about the "species," which is essentially a biconcave variety of *Spiroloc. planulata.*

Of three figures given by Soldani, 'Testaceogr.,' vol. ii, 1798, pl. xix, figs. *l*, *m*, *n* (p. 54, Frumentaria *Sigma et Rhombos*), d'Orbigny chose one (fig. *m*) for his *Spiroloculina limbata* ('Ann. Sci. Nat.,' vol. vii, 1826, p. 299, No. 12). This is a nearly oval *Spiroloculina*, with the outer chambers apparently rounded, and one of them much inflated; the centre is concave. No limbation is shown. This shell is noticed in the 'Ann. Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 248, No. 141, pl. 8, fig. 22, by Parker, Jones, and Brady, as "a bold variety [of *Spiroloculina planulata*] with inflated chambers." The figure there given unfortunately does not express the convexity or roundedness of the outer margin of the chambers, but makes them flat and sharp-edged. If all the chambers had a definitely convex surface, this shell would be allied to the *Sp. nitida* and *rotunda*, d'Orb. As it is, the fig. *m* may be referred to *Sp. excavata.*

Of the two other figures, fig. *l* is oval and concave, with flat chambers; and fig. *n* is like it, but of a narrow-oval outline. These two correspond sufficiently well with *Sp. excavata*, as figured by d'Orbigny, 'Foram. Foss. Vien.,' 1846, p. 271, pl. xvi, figs. 19—21. Fig. *m* is rightly referred by Signor C. Fornasini, 'Bollett. Soc. Geol. Italiana,' vol. v, 1886, p. 238, No. 368, to *Sp. excavata*, d'Orb., but we should think, if Soldani's drawing be true, as a *sub-variety* (such as *inæqualis*) of that form.

Occurrence.—*Spiroloculina excavata* has its home in comparatively shallow water; and it is, for the most part, confined to tropical and the warmer temperate seas. Fossil specimens are recorded from the London Clay of Sheppey, the Miocene of Vienna, the Pliocene (?) of Italy, and the Pliocene Clay of St. Erth. In the Crag we find it at Sutton and Broom Hill.

3. Spiroloculina canaliculata, *d'Orbigny*, 1846. Plate III, figs. 39, 40; Woodcuts, figs. 3 *a*, 3 *b*

Part I, 1866, page 16; and Appendix II, Table, No. 16.

Spiroloculina cymbium, *d'Orb.*, 1839. Hist. Nat. Canaries, p. 140, pl. iii, figs. 5, 6.
— canaliculata, *d'Orb.*, 1846. Foram. Foss. Vienne, p. 269, pl. xvi, figs. 10—12.
— — *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 312, pl. xxiv, fig. 10.
— — var., *Costa*, 1856. Ibid., fig. 9.
— *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 16, pl. iii, figs. 39, 40.
— depressa, *Terquem*, 1878. Mém. Soc. Géol. France, ser. 3, vol. i, p. 54, pl. x, fig. 11.
— canaliculata, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 133, pl. xvii, fig. 12.
— limbata, var., *Brady*, 1884. Report 'Challenger,' p. 150, pl. x, figs. 1, 2.
— planulata, *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 214, pl. xl, figs. 14, 15.
— canaliculata, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., cl. ii, vol. xviii, pp. 218, 224, pl. i, figs. 40, 41.
— impressa, *Egger*, 1893. Ibid., figs. 35, 36.
— — cfr. bicarinata, *d'Orb.*,[1] *Schwager*, 1883. Palæontographica, vol. xxx, p. 85, pl. xxiv, fig. 4.
— depressa, *d'Orbigny*
— perforata, *d'Orbigny*
— Grateloupi, *d'Orbigny*
— bicarinata, *d'Orbigny*
} For notes on these forms see p. 35.

Characters.—Lateral surfaces of the chambers plane, with or without limbate sutures; the peripheral margin channelled; centre usually somewhat concave.

The gradational differences of the test, due to greater or less amount of shell-growth along the edges of the chambers, give rise to some confusion in the classification of the noticeable varieties. If the exogenous or extra shell-growth predominates on the edges of the periphery, it makes a channel along the outer margin. This feature characterises d'Orbigny's well-shaped *Spiroloculina canali-*

[1] As defined by Terquem, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, 1882, p. 155, pl. xxiv, fig. 5.

culata, as well as the less compact and weaker *Sp. cymbium*, and other forms named by him at an earlier date, in 1826.

If the exogenous shell-matter is strong at the sutures of the chambers, there forming vertical lines or ridges on the two lateral surfaces or faces of the shell, we have the *Sp. dorsata*, Reuss, *Sp. limbata*, Bornemann, *Sp. impressa*, Terquem, and some others; but if the two marginal edges are widened out horizontally, the shell has a canaliculate periphery.

This characteristic marginal fluting seems to serve as a useful criterion; and in Part I, page 16, it was used as such, and *Sp. canaliculata* was chosen as the subtype. The above list of synonyms excludes the forms that have square (plane) margins; but several of the varieties have some modification as well in this respect as in sutural limbation, central concavity, and general outline. Indeed, in our fig. 40 the marginal furrow is very feebly developed; even stronger in fig. 38. In the latter the planulate character predominates; in the former, as a marginal channel is formed by limbation of its edges, the limbation of the sutures is here of minor consideration.

The following remarks on some canaliculate *Spiroloculinæ* that have been variously named will show how the minor features are modified, and how complicated the nomenclature has become.

(1) Spiroloculina depressa, *d'Orb*, 1826 ('Ann. Sci. Nat.,' vol. vii, p. 298, No. 1), according to Terquem, 1878 ('Mém. Soc. Géol. France,' ser. 3, vol. i, art. 3, p. 54, pl. x, fig. 11, from d'Orbigny's unedited drawing, pl. i, fig. 1), is *canaliculate* and limbate, hollow-chambered, and slightly excavate (not Williamson's fig. 177, which has an angulate margin); but the *Model* No. 92 having been taken for the type and criterion in 1865 and 1871, it is best to adhere to the conclusion then arrived at of its being *planulata.*

(2) Spiroloculina perforata, *d'Orb.*, 1826 ('Ann. Sci. Nat.,' vol. vii, p. 298, No. 2 ("Modèles, No. 92," is a misprint)), according to Terquem, 1882 ('Mém. Soc. Géol. France,' ser. 3, vol. ii, art. 3, p. 154, pl. xxiv, figs. 3 and 4 (? *Ophthalmidium*), after d'Orbigny's unedited drawing, pl. i, fig. 2), is *canaliculate*, limbate, excavate, and narrow.

(3) Spiroloculina Grateloupi, *d'Orb.*, 1826 ('Ann. Sci. Nat.,' vol. vii, p. 298, No. 3), according to Terquem, 1878 ('Mém. Soc. Géol. France,' ser. 3, vol, i, art. 3, p. 52, pl. x, fig. 5; and var. fig. 6, after d'Orbigny's unedited drawings, pl. i, figs. 9—11; and in 'Mém. Soc. Géol. France,' ser. 3, vol. ii, art. 3, p. 155, pl. xxiv, fig. 6), is *broadly channelled* on margin (*canaliculate*) and limbate.

(4) SPIROLOCULINA BICARINATA, *d'Orb.*, 1826 ('Ann. Sci. Nat.,' vol. vii, p. 298, No. 6), according to Terquem, 1882 ('Mém. Soc. Géol. France,' ser. 3, vol. ii, art. 3, p. 155, pl. xxiv, fig. 5, after d'Orbigny's unedited drawings, pl. i, figs. 1—5), is a neat, small, narrow, *canaliculate* form.

It is evident from *planulata* and *excavata* having sometimes limbate sutures and channelled margin, and *canaliculata* losing its marginal fluting and becoming a flat-edged *dorsata*, that it is really artificial distinctions that separate the forms, and that the leading character in each may be used in this arrangement.

Occurrence.—Recent specimens of *Spiroloculina canaliculata* are not uncommon in the Mediterranean in shallow and moderately deep waters. No specimens are recorded from the 'Challenger' dredgings. As a fossil, *Sp. canaliculata* is recorded from the Plaisancian beds of Piedmont, and from the Miocene of Vienna and Malaga. In the Crag it has been found at Sutton.

4. SPIROLOCULINA DORSATA, *Reuss*, 1866. Woodcuts, figs. 4 and 8 *a*, 8 *b*.

SPIROLOCULINA CRETACEA, *Reuss*, 1854. Densch. k. Akad. Wien, vol. vii, Abth. 1, p. 72, pl. xxvi, fig. 9.
— LIMBATA, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Gesell., vol. vii, p. 348, pl. xix, fig. 1.
— DEPRESSA, *Williamson*, 1857. Rec. Brit. Foram., p. 82, pl. vii, fig. 177. A variety, not square and flat, but angular at the periphery.
— — var. CYMBIUM, *Williamson*, 1857. Ibid., p. 82, pl. vii, fig. 179.
— LIMBATA, *Reuss*, 1863. Sitzungsb. k. Akad. Wiss. Wien, vol. xlviii, p. 64, pl. viii, fig. 89.
— MORLOTI, *Reuss*, 1864. Denksch. k. Akad. Wiss. Wien, vol. xxiii, p. 6, pl. i, fig. 10.
MILIOLA (SPIROLOCULINA) LIMBATA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 409, pl. xvii, fig. 83. (Periphery not quite square, but slightly concave.)
SPIROLOCULINA DORSATA, *Reuss*, 1866. Denksch. k. Akad. Wien, vol. xxv, p. 123.
— "cfr. LIMBATA, *Bornemann*," *Hantken*, 1875. Mitth. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, p. 20, pl. xiii, fig. 2.
— DEPRESSA, *Terquem*, 1875. Anim. plage Dunkerque, p. 38, pl. v, fig. 18.
— IMPRESSA, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. ii, art. 3, p. 53, pl. x, fig. 8.
— LIMBATA, *Brady*, 1884. Rep. 'Chall.,' p. 150, pl. ix, figs. 15—17.

SPIROLOCULINA SOLDANII, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 183, 185, Nos. 46, 156, 157; and 1894, Coll. Soldani, &c.,[1] pp. 20 and 31, pl. 1, figs. 1, 1 *a*.

— LIMBATA (?) = DORSATA, *de Amicis*, 1893. Ibid., vol. xii, fasc. 3, pp. 20, 178, 179.

— cfr. LIMBATA, *d'Orb.*, *de Amicis*, 1893. Ibid., vol. xii, p. 310.

— PLANULATA, *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, p. 107, pl. xviii, figs. 836, 836 *a*. A variety of *dorsata*, inclining to *canaliculata*.

— — — 1894. Ibid., vol. xxv, p. 107, pl. xviii, figs. 836 *b*, 836 *c*.

— LIMBATA, *Goës*, 1894. Ibid., figs. 837 and 837 *a*.

Characters.—Sutures limbate, periphery plane, somewhat concave. Other limbate forms are the narrow and almost excavate *Sp. Lapugyensis* and *cavernosa*, Karrer, 1867 ('Sitzb. Ak. Wien,' vol. lv, pp. 357, 358, pl. ii, figs. 2 and 3).

Von Reuss, in 1866, replaced Bornemann's appellation "*limbata*" by "*dorsata*," because d'Orbigny had already used the former. As the name *dorsata* has been applied by Reuss to two figures representing *Spiroloculina canaliculata* and *Sp. excavata* in von Schlicht's 'Foram. Septarienthones Pietzpuhl,' 1870, pl. xxxvii, figs. 27—32, possibly he regarded these as synonyms.

FIGS. 8 *a*, 8 *b*.—*Spiroloculina dorsata*, Reuss. *a*. View of the complete test, with its limbate sutures. *b*. Edge view from the oral end, showing the square periphery. × 15 (After Brady, 'Challenger' Report, pl. ix, figs. 17 *a*, *b*.)

The name *dorsata* seems to be more applicable to *canaliculata:* and Reuss may have associated the limbate and channelled forms, as was done in Part I of this Monograph, 1866, p. 16. The two together might be diagnosed thus: margins of the chambers more or less limbate, with the shell-growth either marking the sutures, or thickening the outer margins only, and thus fluting the periphery; centre of shell somewhat hollow.

In *Spiroloculinæ* having the surfaces of the chambers hollowed or concave there is usually some amount of either sutural or marginal limbation, which causes

[1] C. Fornasini, 'I Foraminiferi della Collezione Soldani relativa al "Saggio Orittografico," esistente nel Museo Paleontologico del R. Istituto di Studi Superiori in Firenze; con una Tavola,' 8vo., Bologna, 1894, p. 32.

the modification of the planulate form. In other words, those with concave chambers are mostly divisible into either *canaliculata*, d'Orb., or *dorsata*, Reuss.

Occurrence.—*Spiroloculina dorsata* (*limbata*, Bornemann) occurs rather commonly in all the great oceans, as well as in the Mediterranean and Red Seas, in depths not exceeding 400 fathoms. Fossil specimens are recorded from the Miocene of Vienna and Muddy Creek (Victoria), the Oligocene of Hermsdorf, and the Pliocene of Garrucha (South Spain) and St. Erth. In the Crag we find it in every locality examined, except Aldborough.

5. Spiroloculina nitida, *d'Orbigny*, 1826. Variety with a keel. Plate V, fig. 3; Woodcut, fig. 6.

Spiroloculina nitida, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 298, No. 4 (Soldani, vol. i, part 3, p. 229, pl. clv, figs. *ll*, *mm ?*). Acute oval variety.

— rotunda,[1] *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 299, No. 14 (Soldani, vol. i, part 3, p. 229, pl. cliv, fig. *hh*). Circular variety.

— nitida, *Terquem* (after d'Orbigny's unedited drawings), 1878. Mém. Soc. Géol. France, ser. 3, vol. i, art. 3, p. 52, pl. x, fig. 4 (chambers narrow); and 1882, vol. ii, art. 3, p. 157, pl. xxiv, fig. 16 (outside chambers large).

— rotunda, *Terquem* (after d'Orbigny's unedited drawings), 1878 Ibid., ser. 3, vol. i, art. 3, p. 54, pl. x. fig. 10. Rather thicker than Soldani's figures quoted by d'Orbigny.

— No. 556, *von Schlicht*, 1870. Foram. Septar. Pietzpuhl, p. 98, pl. xxxvii, figs. 30—32 (variety).

— nitida, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 248, No. 140, pl. viii, fig. 24.

— rotundata, *Parker, Jones, and Brady*, 1871. Ibid., No. 142, pl. viii, fig. 25.

— infra-oolithica, *Terquem*, 1874. Foram. Syst. Oolith., p. 323, pls. xxxiv and xxxv, figs. 1—12.

— intorta, *Terquem*, 1874. Ibid., p. 325, pl. xxxv, figs. 9, 10.

— vermiformis, *Terquem*, 1874. Ibid., fig. 8.

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[1] The name "*rotunda*" is preferable in one respect, but *nitida* (the oval form) came first in d'Orbigny's naming.

SPIROLOCULINA sp. indet., *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anstalt, vol. iv, p. 20, pl. xiii, fig. 1.
— ROTUNDA, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 54, pl. x, fig. 10.
— INTERRUPTA, *Terquem*, 1878. Ibid., p. 53, pl. x, fig. 9.
— AMPLA, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 132, pl. xvii, fig. 10.
— DESERTORUM, *Schwager*, 1883. Palæontographica, vol. xxx, p. 84, pl. xxiv, fig. 2. (*Sp. rotunda* with imperfect keel.)
— PROBOSCIDEA, *Schwager*, 1883. Ibid., fig. 3. (Long oval *rotunda*, with very slight keel).
TENUISEPTATA, *Brady*, 1884. Rept. 'Challenger,' p. 153, pl. x, figs. 5, 6 (variety).
— ROTUNDATA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 220, No. 294.
— NITIDA, *Fornasini*, 1886. Ibid., vol. v, p. 221, No. 296 (with synonyms).
— MICHALSKII, *Wisniowski*, 1890. Mem. Acad. Sci. Cracow (Pamiet. Wydz. III, Akad. Umiej. Krak.), vol. xvii, p. 8, pl. viii, fig. 6.
— MINIMA, *Wisniowski*, 1890. Ibid., p. 9, pl. viii, fig. 7.
— DIFFICILIS, *Wisniowski*, 1890. Ibid., p. 10, pl. viii, fig. 8.
— NITIDA, *Mariani*, 1891. Boll. Soc. Geol. Ital., vol. x, p. 171, pl. vi, fig. 1.
— TENUISEPTATA, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., cl. ii, vol. xviii, pp. 218 and 223, pl. i, figs. 48, 49.
— (OPHTHALMIDIUM ?) COMPLANATA, *Egger*, 1893. Ibid., p. 225, pl. iii, figs. 7, 8.

Characters.—Chambers convex; shell more or less biconcave; in some cases limbate.

The relationship of this form to *Spiroloculina planulata* has been explained above at p. 104; and reasons are there given why "*nitida*," d'Orb., is chosen instead of "*turgidula*," given by Lamarck to a similar variety, but which we cannot identify.

In the specimen before us (Pl. V, fig. 3) we have a boldly elliptical, or broad-oval, Spiroloculine shell with convex chambers and a distinctly limbate string-course or keel along the outer edge of the last two.

It nearly corresponds with pl. x, figs. 1 and 2, of Brady's *Spiroloculina limbata*, var., pp. 150, 151, Rep. 'Challenger,' 1884. This is a thin subcircular form, in which all the successive outer or over-riding chambers appear to have had the limbate edge. Hence Dr. Brady associated his specimen with Bornemann's

limbata, pointing out that that author had published a good limbate form, and that this name, as generally used, was applied by d'Orbigny to an unsatisfactory specimen of a different kind figured by Soldani (see above, p. 33). He also indicated that the chambers are not at all depressed as in Bornemann's figures, and in the limbate form of "*depressa*" figured by Williamson ('Recent. Brit. Foram.,' p. 82, fig. 177).

Following the artificial grouping explained at page 103, we see that the *Spiroloculina* shown by Pl. V, fig. 3, is not *planulata*, for it has not flat, but somewhat convex or slightly turgid, chambers; nor are they hollowed or depressed along their length, as is usual in *canaliculata* and *dorsata*. Whether or no the outer margins of the earlier chambers were limbate (those edges being now covered up) need not affect the question of the relationship of this from the Crag, and the other from the 'Challenger' dredgings. Had Dr. Brady given a name to his specimens we should have adopted it. It is evidently a limbate subvariety of *nitida*, d'Orb., which is a subtype or variety of the type *Spiroloculina planulata* (Lamarck).

The form under notice has some allies in Terquem's *Spiroloculina angulifera*, 'Mém. Soc. Géol. France,' ser. 3, vol. ii, p. 156, pl. xxiv, figs. 11 and 12 (with their associates among figs. 10—15); and *Sp. alata* (in part), ibid., p. 158, pl. xxiv, fig. 18. Schwager's *Sp. desertorum* and *proboscidea* were very near allies to our fig. 3.

Occurrence.—Spiroloculina nitida. This varietal form of *Sp. planulata* is common in tropical waters and in the Mediterranean. It has been noticed fossil in the Jurassic (Terquem), the Cretaceous (Wizniowski), and the Tertiaries of Hungary, Germany, Italy, and France. In the Crag it has been found only at Sutton.

Note.—(1) Mr. Millett has enumerated in the following lists several other forms of *Spiroloculina*. Some of these are characterised by the *chambers being angular on the exterior surface*. Of these the best type, in his opinion, is *Sp. acutimargo*, Brady.

Spiroloculina poeyanana, *d'Orbigny*, 1839. Foram. Cuba, p. 168, pl. x, figs. 1, 2.
— ornata, *d'Orbigny*, 1839. Ibid., p. 167, pl. xii, fig. 7.
— tenuirostra, *Karrer*, 1867. Sitz. k. Akad. Wiss. Wien, vol. lv, Abth. 1, p. 358, pl. ii, fig. 5.
— disparilis ?, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 55, pl. x, fig. 12.
— affixa, *Terquem*, 1878. Ibid., fig. 13.
— angulosa, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 132, pl. xvii, fig. 9.
— laminata, *Terquem*, 1881. Ibid., p. 133, pl. xvii, fig. 11.

SPIROLOCULINA ROBUSTA, *Brady*, 1884. 'Challenger' Rept., p. 150, pl. ix, figs. 7, 8.
— ACUTIMARGO, *Brady*, 1884. Ibid., p. 154, pl. x, figs. 12—15.
— — *Balkwill and Wright*, 1885. Trans. Roy. Irish Acad., vol. xxviii, p. 323, fig. 1.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., cl. ii, vol. xviii, p. 222, pl. i, figs. 26—28.
— LAMELLA, *Egger*, 1893. Ibid., p. 223, pl. i, figs. 24, 25.

(2) Mr. Millett also indicates others having the *whorls externally concave*, like figs. 39 and 40 in our Plate III.

MILIOLA CONCENTRICA, *Brown*, 1844. Illustr. Rec. Conch. Gt. Brit., p. 3, pl. lvi, fig. 22.
SPIROLOCULINA PANDA, *Schwager*, 1865. Württ. Naturwiss. Jahreshefte, Jahrg. 21, p. 95, pl. ii, fig. 6.
— CANALICULATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 16, pl. iii, figs. 39 and 40.
— No. 555, *v. Schlicht*, 1870. Foram. Pietzpuhl, p. 98, pl. xxxvii, figs. 27—29 ("*Sp. dorsata*," Reuss).
— ANGULOSA, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 53, pl. v (x), fig. 7.
— CANALICULATA, *Vine*, 1878. Science Gossip, vol. xiv, p. 53, fig. 37.
— CRASSA, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 152, pl. xiv, fig. 10.
— EXCAVATA, *Schlumberger*, 1893. Mém. Soc. Zool. Fr., vol. vi, p. 201, pl. iii, fig. 68; and fig. 1, p. 201.
— DEPRESSA, *Schlumberger*, 1893. Ibid., p. 202, pl. iii, fig. 69; and fig. 2, p. 202.
— INÆQUILATERALIS, *Schlumberger*, 1893. Ibid., pl. iv, figs. 84—86; and fig. 3, p. 202.

(3) Also others that have their *chambers externally concave* together with *limbate sutures* or *striate surface*.

SPIROLOCULINA EXCAVATA, *Costa*, 1856. Atti Accad. Pont., vol. vii, fasc. 2, p. 311, pl. xxiv, fig. 11.
— STRIATELLA, *Reuss*, 1864. Denks. k. Akad. Wiss. Wien, vol. xxiii, p. 7, pl. i, fig. 8.
— DEPRESSA, *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 38, pl. v, fig. 18.
— IMPRESSA, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 53, pl. x, fig. 8.
— GRATELOUPI, *Terquem*, 1878. Ibid., p. 52, pl. v (x), fig. 5.
— — *Idem*, 1882. Ibid., vol. ii, p. 155, pl. xxiv, fig. 6.
— BICARINATA, *Terquem*, 1882. Ibid., fig. 5.

SPIROLOCULINA IMPRESSA,[1] *Brady*, 1884. 'Challenger' Report, p. 151, pl. x, figs. 3, 4.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., cl. ii, vol. xviii, p. 224, pl. i, figs. 35, 36.

(4) Besides the *Spiroloculinæ* enumerated with foregoing lists, Mr. Millett observes that there are many which agree with some of the others in certain respects as regards the shape of the whorls, but are variously ornamented, and therefore worthy of separate consideration. Some also are arenaceous.

There remain some others which do not readily fall into this classification.

Genus 3.—MILIOLINA, *Williamson*, 1858.

Part I, 1866, page 4 (*Miliola*, Lamarck, 1804). See also Brady, Report 'Challenger,' 1884, pp. 156—182.

General Characters.—Originally intended by Williamson to comprise the three forms—*Triloculina*, *Quinqueloculina*, and *Adelosina*—we still find it convenient to retain *Miliolina* on account of the close relationship found to exist between these forms as to both external and internal characters. The interesting peculiarities of their structure, as elaborated by MM. Munier-Chalmas and Schlumberger, are alluded to in some detail above at pages 91, 92.

1. MILIOLINA SEMINULUM (*Linné*). Plate III, figs. 35, 36.

Part I, 1866, page 9; and Appendix II, Table, No. 9.

Additional Synonyms:

QUINQUELOCULINA SEMINULUM, *J., P., and B.*, 1866. Monogr. For. Crag., p. 9, No. 1, pl. iii, figs. 35, 36.
MILIOLINA SEMINULUM, *Hartwig*, 1866. The Sea, 3rd edit., p. 381, fig. *g*.
— — *Cooke*, 1869. Thous. Objects Micr., p. 93, pl. ix, fig. 21.
— — *Chimmo*, 1870. Bed of Atlantic, p. 19, pl. iv, fig. 2.
— — *Greene*, 1871. Manual Protozoa, p. 15, fig. 3, *g*.

[1] *Spiroloculina impressa*, with the outer margin channelled, comes also under the quasi-specific group of *Sp. canaliculata* (see p. 108), thus furnishing a striking example of the intercommunity of Foraminiferal forms; so also our Pl. III, figs. 39, 40, referred to above. Other instances of one "species" showing the characteristics of another may be pointed out.

QUINQUELOCULINA SEMILUNUM [SEMINULUM], *Terquem*, 1875. Anim. plage Dunkerque, fasc. 1, p. 40, pl. vi, fig. 8.

MILIOLA (QUINQUELOCULINA) SEMINULUM, *Jones*, 1878. In Dixon's Geol. Sussex, 2nd edit., p. 172, pl. x, fig. 9.

QUINQUELOCULINA PLANA, *Terquem* (after *d'Orbigny*), 1878. Mém. Soc. Géol., France, ser. 3, vol. i, No. 3, p. 63, pl. vi (xi), figs. 6 *a*, *b*, *c*.

— VULGARIS, *Terquem* (after *d'Orbigny*), 1878. Ibid., p. 66, pl. xi, figs. 20 *a*, *b*, *c*, and 21.

MILIOLINA SEMINULUM (and varieties), *Goës*, 1882. K. Svenska Vet.-Akad. Handl., vol. xix, part 4, pp. 122—130.

— — *Brady*, 1884. Report 'Challenger,' pp. 157—160 (with cuts, figs. 3 *a*, *b*, *c*), pl. v, fig. 6.

— — *Sherborn and Chapman*, 1886. Journ. Roy. Microsc. Soc., ser. 2, vol. vi, p. 742, pl. xiv, fig. 1.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 217.

— — *Fornasini*, 1887. Ibid., vol. vi, fasc. 1, pp. 11 (with synonyms) and 13.

— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 214, pl. xl, figs. 23, 31.

— — *Anon.* [*Chapman*], 1888. Scient. News, 1888, p. 389, fig. 5.

— — *Terrigi*, 1889. Mem. R. Accad. Lincei, vol. vi, p. 103, pl. iv, figs. 2, 3, 4, 11, 12.

QUINQUELOCULINA VULGARIS, *Fornasini*, 1893. Mem. R. Accad. Bologna, ser. 5, vol. iii, p. 439, pl. i, figs. 2, 2 *a*, 2 *b*.

— — *Schlumberger*, 1893. Mém. Soc. Zool. France, vol. vi, p. 65, figs. 13, 14, pl. ii, figs. 65, 66. Round form like fig. 3 *c*, p. 159, Rep. 'Challenger.'

— SEMINULUM, *Schlumberger*, 1893. Ibid., vol. vi, p. 66, figs. 15, 16, pl. iv, figs. 80, 81. Oval form like fig. 3 *a*, p. 159, Rep. 'Chall.'

MILIOLINA SEMINULUM, *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 25, 178, 179, 315—317.

QUINQUELOCULINA SEMINULUM, *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 20.

Characters.—In the 'Kongl. Svenska Vetenskap-Akad. Handlingar,' vol. x, No. 4, 1882, Dr. A. Goës has given an illustrated synopsis of the principal varieties of the Foraminifera obtained from the Caribbean Sea, limiting himself to the consideration of true species, and not recognising merely stages and accidents of growth as the basis for distinctions. At pages 122 and 123 *Miliolina seminulum* (Linné) is taken as the central type for the following

varieties:—*scapha*, d'Orb.; *triangularis*, d'Orb.; *trigonula*, Lamarck; *agglutinans*, d'Orb.; *pulchella*, d'Orb.; *Brongniartii*, d'Orb. At pages 124—130 he groups numerous forms of the above (shown in his plates xi and xii) by the chief external characters.

In 1894, in the same Swedish Academy Transactions, vol. xxiv, Dr. Goës treats of *Miliolina seminulum* and its allies at pages 108—112.

It is not necessary here to add to the description of this Foraminifer given by Parker and Jones in the 'Annals and Mag. Nat. Hist.,' ser. 2, vol. xix, 1857, p. 300; and by Williamson, 'Recent Brit. Foram.,' 1858, pp. 85—87, or to the remarks already made in Part I, 1866, and by Goës in 1882, and Brady in 1884. The additional synonyms above quoted show how frequently this Foraminifer has been met with and more or less studied by naturalists.

Occurrence.—*Miliolina seminulum* has a world-wide range, and occurs at all depths to 3000 fathoms. Geologically it occurs in every deposit from the Lower Eocene upwards.

2. Miliolina triangularis (*d'Orbigny*). Plate IV, fig. 1; Plate VI, figs. 2 *a*, 2 *b*.

Part I, 1866, page 10; and Appendix II, Table, No. 8.

Additional Synonyms:

Quinqueloculina triangularis, *J., P., and B.*, 1866. Monogr. For. Crag, p. 10, No. 2, pl. iv, fig. 1.
— — *Terquem* (after *d'Orbigny*), 1878. Mém. Soc. Géol. France, ser. 3, vol. i, No. 3, p. 67, pl. viii (xii), figs. 1—9.
Triloculina triquetra, *Terquem*, 1882. Ibid., vol. ii, No. 3, p. 164, pl. xvi (xxiv), figs. 36, 37.
Miliolina triangularis (var. of M. seminulum), *Brady*, 1884. Report 'Challenger,' p. 157.

Characters.—This appears to be one of the large and trihedral recognisable varieties of the *Miliolina seminulum*, so changeable in its aspect according to the variable evolution of its chambers. As such it seems advisable to keep it distinct in this Monograph. It is more oval in the lateral aspect, and more triangular in its end view, than the smaller *M. subrotunda*—a near ally.

Occurrence.—There is a difficulty in settling the mutual synonymy of this form and *M. tricarinata*; and the occurrences mentioned for *M. triangularis* in Part I may be regarded as sufficient.

3. Miliolina Cuvieriana (*d'Orbigny*). Plate VI, figs. 3 *a*, 3 *b*.

Quinqueloculina Cuvieriana, *d'Orbigny*, 1839. Foram. Cuba, p. 190, pl. xi, figs. 19—21.
— Lamarckiana, *d'Orbigny*. Ibid., p. 189, pl. xi, figs. 14, 15.
Miliolina Cuvieriana, *Brady*, 1884. Report 'Challenger,' p. 162, pl. v, figs. 12 *a, b, c*.

Characters.—This form shows five angles in its end view; the weaker individual figured by d'Orbigny as *Lamarckiana* has only four projecting chambers (l. c., fig. 15). Thus both differ from *M. triangularis* so far as the relative protrusion of the chambers is concerned, but not essentially otherwise.

Occurrence.—*Miliolina Cuvieriana* is essentially a shallow-water form. The type-specimens were obtained by d'Orbigny from the shores of Cuba and Jamaica. Those mentioned in the 'Challenger' Report are from Japan, the Eastern Archipelago, and the Philippine Islands, and were found at depths ranging from six to ninety-five fathoms. As a fossil this species apparently occurs rarely. It has lately been found in the Miocene of Muddy Creek (Victoria); and the Crag specimens were obtained from Gomer (Gedgrave).

4. Miliolina tricarinata (*d'Orbigny*). Plate III, figs. 33, 34.

Part I, 1866, page 7; and Appendix II, Table, No. 6.

Additional Synonyms:

Triloculina tricarinata, *J., P., and B.*, 1866. Monogr. For. Crag., p. 7, No. 1, pl. iii, figs. 33, 34.
— angularis, *Terquem* (after *d'Orbigny*), 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, No. 3, p. 163, pl. xvi (xxiv), figs. 34, 35.
Miliolina tricarinata, *Brady*, 1884. Report 'Challenger,' p. 165, pl. iii, fig. 17.
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 30, 178, 179, 320.
— — *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 114, pl. xxi, figs. 866—869.
Triloculina tricarinata, *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 20.

Characters.—A distinct and usually symmetrical Triloculine *Miliolina*.

Occurrence.—*Miliolina tricarinata* is found in all seas and at all depths. Until Mr. Chapman's recent researches in the Gault of Folkestone its occurrence in a

fossil state was not recorded lower than the Tertiary. From the latter deposits specimens have been noted from the Calcaire Grossier of the Paris Basin, London Clay, Miocene of Muddy Creek, Australia, Italian Pliocene (de Amicis), and the St. Erth Clay (Millett). In the Crag it has been met with only at Sutton, and there rarely.

5. Miliolina oblonga (*Montagu*). Plate III, figs. 31, 32; and Plate V, fig. 5.

Part I, 1866, page 7; and Appendix II, Table, No. 7.

Additional Synonyms :

Triloculina (Quinqueloculina) oblonga, *J., P., and B.*, 1866. Monogr. For. Crag., p. 7, No. 2, pl. iii, figs. 31, 32.
— oblonga, *Terquem*, 1875. Plage Dunkerque, p. 38, pl. v, fig. 19.
Quinqueloculina oblonga, *Terquem*, 1875, Ibid., p. 40, pl. vi, fig. 10; and 1876, ibid., p. 85, pl. xii, figs. 6 *a*, *b*.
Triloculina oblonga, *Terquem*, 1878. Mém. Soc. Géol. France, ser. 3, vol. i, p. 58, pl. v (x), figs. 22—24.
Miliolina oblonga, *Brady*, 1884. Report 'Challenger,' p. 160, pl. v, fig. 4.
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 27, 178, 179, 317.
— — *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 110, pl. xx, figs. 850, 850*f*.

Characters.—This Milioline form, usually showing three, but sometimes five faces, is nevertheless one of the most persistent in shape among the allied varieties of the type *seminulum*.

Occurrence.—*Miliolina oblonga* is found in all seas and at all depths, but the finest specimens come from the shallower waters of the temperate zones. As a fossil it has been recorded from the Upper Chalk of Taplow, the London Clay, the Miocene of Muddy Creek, the Pliocene of St. Erth and Italy. In the Crag it is a common Foraminifer in nearly every zone examined.

6. Miliolina subrotunda (*Montagu*). Woodcut, fig. 9.

Part I, 1866, page 11; and Appendix II, Table, No. 10.

Additional Synonyms :

Quinqueloculina subrotunda, *J., P., and B.*, 1866. Monogr. For. Crag, p. 11, No. 3.
— — *Terquem*, 1875. Plage Dunkerq., p. 39, pl. vi, fig. 4.

MILIOLINA SUBROTUNDA, *Brady*, 1884. Report 'Challenger,' p. 168, pl. v, figs. 10 and 11.
— — *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 109, pl. xix, figs. 846—847 *h*. With synonyms.

Characters.—This variable but sufficiently recognisable form was mentioned in Part I, p. 11, as having occurred in the Crag at Sutton, but lost before it could be drawn. A figure of another specimen is now given.

FIG. 9.—*Miliolina subrotunda*; magn. 50 diam. (After Brady, 'Challenger' Report, pl. v, fig. 11.)

Occurrence.—*Miliolina subrotunda* is essentially a shallow-water form. It is recorded from the Arctic Seas (Parker and Jones), from several localities in the Atlantic, and from the French and English coasts. Geologically it occurs in the Miocene of Vienna and Bordeaux, the Pliocene of St. Erth, and the Crag. The Crag specimen was found at Sutton.

7. MILIOLINA CIRCULARIS (*Bornemann*). Plate V, fig. 4.

TRILOCULINA CIRCULARIS, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Gesell., vol. vii, p. 349, pl. xix, fig. 4.
MILIOLINA CIRCULARIS, *Brady*, 1884. Report 'Challenger,' p. 169, pl. iv, fig. 3; and pl. v, figs. 13, 14 (?).
— — *Sherborn and Chapman.* Journ. R. Microsc. Soc., ser. 2, vol. vi, pl. xiv, fig. 2.

Characters.—This is a near ally of *M. subrotunda*, with a more convex shell and more closely enwrapping chambers.

Occurrence.—*Miliolina circularis* appears to be rare in recent seas, and to be confined to comparatively shallow water. The 'Challenger' records are from Prince Edward's Island, Kerguelen Island, and the Bass Strait. As a fossil it is recorded from the London Clay of Piccadilly, Oligocene of Hermsdorf, and quite recently from the older Pliocene of St. Erth (Millett). The figured specimen is from the Coralline Crag of Suffolk,—exact locality unknown.

8. MILIOLINA BICORNIS (*Walker and Jacob*); including *M. Brongniartii*. Plate III, figs. 41, 42; and var. Plate IV, fig. 2.

Part I, 1866, page 14; and Appendix II, Table, No. 14.

Additional Synonyms:

Frumentaria *fœniculum, Soldani,* 1795. Testaceograph, &c., vol. i, part 3, p. 229, pl. cliv, figs. *bb—gg*.
— *Fœniculum, Soldani,* 1798. Ibid., vol. ii, p. 54, pl. xix, figs. *i, k*.
— *phialiformia, Soldani,* 1798. Ibid., pl. xx, figs. *t, v*.
ADELOSINA STRIATA, *d'Orb,* 1826. Ann. Sci. Nat., vol. vii, p. 304, No. 2; Modèles 18 and 97.
TRILOCULINA BRONGNIARTII, *d'Orb.,* 1827. Ann. Sci. Nat., vol. vii, p. 300, No. 23.
— BRONGNIARTIANA, *d'Orb.,* 1839. For. Cuba, p. 176, pl. x, figs. 6—8.
QUINQUELOCULINA BRONGNIARTII, *P., J., and B.,* 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, pp. 21 and 34, pl. i, figs. 14, 15.
— — *J., P., and B.,* 1866. Monogr. Foram. Crag, p. 14, No. 7, pl. iii, figs. 41, 42; pl. iv, fig. 2.
— BICORNIS, *Terquem,* 1875. Plage Dunkerque, p. 39, pl. vi, fig. 6.
MILIOLINA BICORNIS and BRONGNIARTI, *Brady,* 1884. Report 'Challenger,' p. 171, pl. vi, figs. 9, 11, 12.
TRILOCULINA BRONGNIARTI, MILIOLINA BICORNIS, *Fornasini,* 1886. Boll. Soc. Geol. Ital., vol. v, p. 220, No. 291 (with synonyms).
ADELOSINA BICORNIS (including A. BRONGNIARTII), *Schlumberger,* 1886. Bull. Soc. Zool. France, vol. xi, p. 546—552, with figs. 1—5, 7, and 8 in the text, pl. xvi, figs. 10—15.
MILIOLINA BICORNIS, *de Amicis,* 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 31, 178, 179, 322.
— — *Goës,* 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 113, pl. xxi, figs. 860, 861 *e*.

Characters.—At page 14 of Part I *M. bicornis* was referred to as being allied to *M. Brongniartii;* the two forms are now recognised as two stages of the same Foraminifer, indeed M. Schlumberger has shown that in their first stage the shell is an *Adelosina*, and passes on to the three- and five-chambered condition, and that the slight striation visible in the Adelosine stage is retained in *M. bicornis*, and is much augmented in the more complex *M. Brongniartii*. M. Schlumberger groups them under *Adelosina*, as already explained; here it is thought best to use *Miliolina* as the generic name.

Occurrence.—*Miliolina bicornis* is a shallow-water form. It occurs in all temperate and tropical latitudes, and is common on the British coasts. Fossil specimens have been obtained from the Eocene of the Paris Basin and the London Clay, from the Miocene of Vienna, and Muddy Creek (Victoria), and from the Pliocene of Italy and St. Erth. In the Crag it has been found at Sutton only.

8*. Miliolina bicornis (*Montagu*), Variety. Plate III, figs. 41, 42 (*Q. Brongniartii*).

Quinqueloculina Boueana, *d'Orb.*, 1846. Foram. Foss. Vien., p. 293, pl. xix, figs. 7—9.
— gregaria, *Andreae*, 1884. Abhandl. geol. Specialkarte von Elsass-Loth., vol. ii, p. 279, pl. xii, figs. 10, 11.
Miliolina Boueana, *Brady*, 1884. Rep. 'Challenger,' p. 173, pl. vii, fig. 13.
— scrobiculata, *Brady*, 1884. Ibid., p. 173, pl. cxiii, fig. 15.
— Boueana, *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 114, pl. xxi, figs. 865, 865 *a, b*.

Characters.—Short, compact; chambers rounded. As varieties of *Miliolina bicornis* (*Brongniartii*), Dr. Brady (op. cit., page 173) refers to *M. Boueana* (d'Orb.), *M. Nussdorfensis* (d'Orb.), *M. striatella* (Karrer), and *M. costata* (Terquem); and states that his *M. scrobiculata* is probably a variety of the same species.

So also Dr. Goës (op. cit., p. 114) combines these and others in the same varietal group.

Occurrence.—The striated adult form of *Miliolina bicornis*, often figured under the name of *M. Brongniartii*, may be taken as the immediate relative of this variety *Boueana;* and, as such, its range is of interest.

Recent specimens of *M. Brongniartii* are of rather common occurrence in the shallower waters of the Mediterranean and of most tropical seas. It has also been found off the coast of Galway. Fossil specimens have been recorded from the Eocene of the Paris Basin, the Miocene of Vienna, of Baljik (Bulgaria), and of Muddy Creek (Victoria); the Tertiary beds of Palermo; and the Pliocene of St. Erth. In the Coralline Crag it has been found at Sutton only.

9. Miliolina pulchella (*d'Orbigny*). Plate IV, fig. 3; Plate VI, fig. 3.

Part I, 1866, page 13; and Appendix II, Table, No. 13.

Additional Synonyms:

Adelosina pulchella, *d'Orb.*, 1846. Foram. Foss. Vien., p. 303, pl. xx, figs. 25—30.

QUINQUELOCULINA PULCHELLA, *Terquem* (after *d'Orbigny*), 1878. Mém. Soc. Géol. France, ser. 3, vol. i, No. 3, p. 68, pl. xii, figs. 11—14.

MILIOLINA PULCHELLA, *Brady*, 1884. Report 'Challenger,' p. 174, pl. vi, figs. 13, 14; pl. iii, figs. 10—13 (young forms).

QUINQUELOCULINA PULCHELLA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 219 and 222.

ADELOSINA DUTHIERSI, *Schlumberger*, 1886. Bull. Soc. Zool. France, vol. xi, pp. 553, 554, with fig. 9 in the text, pl. xvi, figs. 16—18.

— PULCHELLA, *Fornasini*, 1894. Foram. Collez. Soldani, Sagg. Oritt., p. 20.

MILIOLINA PULCHELLA, *Goës*, 1894. K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 114, pl. xxi, figs. 862—864.

Characters.—A bold, somewhat irregular, costate, quinqueloculine shell; the longitudinal ridges, furrows, and smaller striæ vary in intensity.

Several similar forms have been figured under different names, as shown by the synonyms given in Part I, p. 13, by Brady, loc. cit., and by Dr. Goës, loc. cit.

Occurrence.—The habitat of *Miliolina pulchella* is in the comparatively shallow waters of temperate and subtropical seas. It is not commonly recorded in a fossil condition, but it has been obtained in the Miocene of Vienna, the Newer Tertiaries of Italy, and the Upper Pliocene of the Island of Rhodes. In the Crag it has been found, in addition to the specimen recorded from Sutton, from Broom Hill, zones **d** and **e**.

10. MILIOLINA FERUSSACII (*d'Orbigny*), variety. Plate IV, fig. 4.

Part I, 1866, page 12; and Appendix II, Table, No. 12.

Characters.—This variety differs from the accepted type of *M. Ferussacii*, especially in being broad instead of narrow, and in having fewer ribs or ridges. The gradations, however, can be seen in *Quinqueloculina Juleana*, *Rodolphina*, and *Mariæ*, d'Orb., 'Foram. Foss. Vienne,' 1846, pp. 298—300, pl. xx, figs. 1—3, 7—9, and 13—15, and particularly *Q. Juleana* as represented by Terquem, 'Anim. Plage Dunkerque,' fasc. 1, 1875, p. 40, pl. vi, figs. 9 *a*—*c*.

Occurrence.—The species itself has a wide geographical range, but appears to be confined to comparatively shallow water. Fossil specimens have been obtained from the Gault of Folkestone (Chapman), the Calcaire grossier of the Paris Basin, from the London Clay (Piccadilly), the Miocene of Vienna and of Muddy Creek (Victoria), and the Pliocene of Italy and St. Erth. In the Crag, in addition to

the occurrence already recorded at Sutton, we find it at Sudbourne Hall, Broom Hill, and Gedgrave.

Sub-family 2.—HAUERININÆ.

Brady's Report 'Challenger,' 1884, *pp.* 62 *and* 182.

Characters.—Chambers partly milioline, partly planospiral or linear.

Genus 1.—SIGMOÏLINA, *Schlumberger*, 1887.

General Characters.—Shell spiroloculine or quinqueloculine; chambers at first milioline, afterwards planospiral, with the outer margins of the chambers overlapping on the alternate sides. Transverse section shows two curved sets of chambers making a more or less sigmoidal pattern.

1. SIGMOÏLINA TENUIS (*Czjzek*), 1847. Plate VII, fig. 2.

QUINQUELOCULINA TENUIS, *Czjzek*, 1847. Haidingers Naturw. Abhandl., vol. ii, p. 149, pl. xiii, figs. 31—34.
— — *Reuss*, 1849. Denksch. k. Akad. Wien, vol. i, p. 385, pl. l, figs. 8 *a—c*.
SPIROLOCULINA ROSTRATA (?), *Reuss*, 1849. Ibid., p. 382, pl. xlix, fig. 7.
QUINQUELOCULINA TENUIS, *Reuss*, 1851. Zeitsch. Deutsch. geol. Gesell, vol. iii, p. 87, pl. vii, fig. 87.
— — *P. and J.*, 1865. Phil. Trans., vol. clv, p. 411, pl. xvii, fig. 84.
SPIROLOCULINA TENUISSIMA, *Reuss*, 1867. Sitzungsb. k. Akad. Wiss. Wien, vol. lv, p. 71, pl. i, fig. 11.
QUINQUELOCULINA, No. 551, *Schlicht*, 1870. Foram. Pietzpuhl, p. 97, pl. xxxvii, figs. 11—13 (= *Spiroloculina tenuis*, Reuss, Sitz. Akad. Wiss., vol. lxii, 1870, p. 456, No. 2).
SPIROLOCULINA (undetermined), *Hantken* (1875), 1881. Mitth. a. d. Jahrb. k. Ungar. geol. Anstalt, vol. iv, p. 20, pl. xiii, fig. 1.
— BERCHTOLDSDORFENSIS, *Karrer*, 1877. Geol. K. F.-J. Wasserleitung, p. 375, pl. 16 *a*, fig. 10.
— FOLIACEA, *Schwager*, 1878. Boll. R. Com. Geol. Ital., vol. ix, p. 529, fig. 20.
QUINQUELOCULINA TENUIS, *Siddall*, 1878. Proc. Chester Soc. N. Sci., pt. ii, p. 46.
SPIROLOCULINA TENUIS, *Brady*, 1884. Rep. 'Challenger,' p. 152, pl. x, figs. 7—11.
MILIOLINA TENUIS, *Balkwill and Wright*, 1885. Tr. R. I. Acad., vol. xxviii (Sci.), p. 324, pl. xii, figs. 3—5.

Spiroloculina panda, var. Rengerriana, *Deecke*, 1886. Mém. Soc. Émul. Montbeliard, ser. 3, vol. xvi, p. 16, pl. i, fig. 28.
Sigmoïlina tenuis, *Schlumberger*, 1887. Bullet. Soc. Zool. Fr., vol. xii, p. 117.
Spiroloculina tenuis, *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Microsc. Soc., for 1890, p. 551, pl. viii, figs. 2—4.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, pp. 22, 178, 179, 312.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 222, pl. i, figs. 46, 47.

Characters.—Thin, nearly complanate, but somewhat curved or twisted on itself.

Occurrence.—*Sigmoïlina tenuis* has a very wide geographical range, and is found in shallow waters and at all depths down to nearly 3000 fathoms. Fossil specimens have been obtained from the Red Chalk of Speeton, the Oligocene of Elsass, the Miocene of the Vienna Basin and of Italy, the Pliocene of Italy and Garrucha, and the Diestian of Antwerp. The Crag specimens were obtained from Sutton, zone **e**, and from Sudbourne.

Sub-family 3.—Peneroplidinæ.

General Characters.—Planospiral or cyclical, sometimes crozier-shaped; bilaterally symmetrical.

Genus 1.—Cornuspira, *Schlutze*, 1854.

Brady's Report 'Challenger,' 1884, *pp.* 62 *and* 198.

Part I, 1866, page 1; and Appendix II, Table, Nos. 1 & 2.

General Characters.—A planospiral undivided tube.

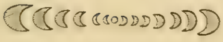
Of the several forms referable to *Cornuspira*, the following may be accepted as recognisable "species," *according to the relative width and involution of the whorls.*

10*a*

10*b*

Figs. 10*a*, 10*b*.—The outer whorl very wide (typical); inner whorls many and thin. *Cornuspira foliacea* (Philippi), 1844.

11a


11b


FIGS. 11*a*, 11*b*.—The outer whorls thick and rather wide; inner whorls many and thin; the inner margins partly overlap the previous whorls. *Cornuspira involvens*, Reuss, 1849.

12a


12b


FIGS. 12*a*, 12*b*.—A few rather wide and thick whorls outside (too thin in fig. 12*b*); inner whorls many and thin. *Cornuspira Reussi*, Bornemann, 1855.

13a


13b


FIGS. 13*a*, 13*b*.—Whorls numerous; the outer whorls slightly wider than the others. *Cornuspira polygyra*, Reuss, 1863.

14a


14b


FIGS. 14*a*, 14*b*.—Numerous whorls, narrow throughout; but the younger whorls are somewhat thicker, especially the last three or four. *Cornuspira angigyra*, Reuss, 1849.

15a


15b


FIGS. 15*a*, 15*b*.—Whorls few and uniformly wide and thick throughout. *Cornuspira pachygyra*, Gümbel, 1869.

The last-mentioned form is much like the young *Cornuspira*, whether "*C. involvens*" (megalospheric), figured in Brady's 'Challenger' Report, pl. xi, fig. 3, or the young "*Spirillina foliacea*" (microspheric) in Williamson's 'Recent Foram. Great Britain,' pl. vii, fig. 201. *Cornuspira planorbis*, Schultze, 'Organism. Polythal.,' 1854, p. 40, pl. ii, fig. 21, and *C. foliacea*, Moebius, 'Meeresfauna Mauritius, &c.,' 1880, p. 76, pl. ii, fig. 3, appear to be quite the same as Brady's young "*C. involvens*."

The *Cyclogyra multiplex* of Searles V. Wood, 'Ann. Mag. Nat. Hist.,' vol. ix, 1842, p. 458, pl. v, fig. 5, is very much like the foregoing forms with whorls of uniform width, except in its large size ($\frac{1}{7}$ inch). Mr. S. V. Wood refused to place it in *Cornuspira*, and thought that it was annelidan.

1. Cornuspira foliacea (*Philippi*), 1884. Plate III, figs. 50, 51; woodcuts, figs. 10 *a*, 10 *b*.

Additional synonyms for the list at page 2 of Part I, 1866; see also Appendix II, Table, No. 1.

Operculina ammonitiformis, *Costa*, 1856. Atti Accad. Pontaniana, vol. vii, fasc. 2, p. 209, pl. xvii, figs. 16 *a*, A, B.
Cornuspira [not named], *Wallich*, 1862. North-Atlantic Sea-Bed, pl. v, figs. 12, 12 *a*, and 15.
— — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 408, pl. xv, fig. 33.
Cornuspiridea, No. 525 (?), & No. 526, *Schlicht*, 1870. Foram. Pietzpuhl, p. 92, pl. xxxv, figs. 9 & 10 (?), 11 & 12.
Spirillina foliacea, *Terquem*, 1876. Plage Dunkerque, fasc. 2, p. 68, pl. vii, fig. 11.
Cornuspira foliacea, *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 27, fig. 104.
— — *Möbius*, 1880. Beitr. Meeresfauna Insel Mauritius, p. 76, pl. ii, fig. 3.
— — *Goës*, 1882. K. Svenska Vet.-Akad. Handl., vol. xix, No. 4, p. 120, pl. ix, figs. 308—310.
— — *Brady*, 1884. 'Challenger' Report, p. 199, pl. xi, figs. 5—9.
— — *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci.), p. 326, pl. xii, figs. 1 *a*, *b*.
— — *Fornasini*, 1893. Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. iii, p. 431, pl. i, fig. 4.
— — *Egger*, 1893. Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii, Abth. ii, p. 247, pl. iii, figs. 20, 21.

2. Cornuspira involvens (*Reuss*), 1849 and 1863. Plate III, figs. 52—54; woodcuts figs. 11 *a*, 11 *b*.

Additional synonyms for the list at page 3, Part I, 1866; see also Appendix II, Table, No. 2.

Cornuspira involvens, *Reuss*, 1863. Sitz. k. Akad Wiss. Wien, vol. xlviii, p. 39, pl. i, fig. 2.
— — *Hantken* (1875), 1881. Mitth. a. d. Jahrb. k. Ungar. Geol. Anst., vol. iv, p. 19, pl. ii, fig. 2.
— — *Brady*, 1884. 'Challenger' Report, p. 200, pl. xi, figs. 1—3.
— — *Balkwill and Millett*, 1884. Journ. Micr. Nat. Science, vol. iii, p. 23, pl. i, fig. 1.
— — *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci.), p. 327, pl. xii, figs. 2 *a*, *b*.

CORNUSPIRA INVOLVENS, *Anon.* [*Chapman*], 1888. Science News, April, p. 389, fig. 7.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 216, pl. xl, figs. 1—3.

Whether the foregoing scheme (p. 126) will hold good when the test of micro- and megalo-spheres (see p. 90) comes to be applied is doubtful. A modification of this scheme, leading to a more natural classification of the *Cornuspiræ*, has been worked out by our collaborateur, Mr. F. W. Millett, with the synonymy in full. It is based upon the form (more or less actual or presumed) of the transverse section of the animal as shown in the woodcut illustrations (figs. 10—15) at pages 126, 127, which were prepared according to Mr. Millett's suggestion. The following lists of the published figures are arranged by Mr. Millett on this plan and in zoological series, instead of in the usual chronological order of dates.

1. Animal much compressed, increasing suddenly in width. Type—*Cornuspira foliacea* (Philippi), 1844; see figs. 10 *a*, 10 *b*.

Cornuspira foliacea, *Williamson*, 1857 (figs. 199, 200).
— — *Jones, Parker and Brady*, 1866.
— — *Balkwill and Wright*, 1885.
— — *Goës*, 1882.
— — *Reuss*, 1865.
— — var. cassis, *Reuss*, 1870 (*Schlicht*, No. 520, 1870).
— — *Brady*, 1884.
— — *Schwager*, 1877.
— — (not named) *Wallich*, 1862.
Operculina ammonitiformis, *Costa*, 1856.
Orbis foliaceus, *Philippi*, 1844.
Operculina plicata, *Czjzek*, 1848.
Cornuspira Reussi (*Bornemann*), *Reuss*, 1870 (*Schlicht*, No. 525, 1870).
— foliacea, *Fornasini*, 1893.
— tenuissima, *Schwager*, 1865.
— — (not named) *Carpenter*, 1885.
— striolata, *Brady*, 1884.

2. Compressed, whorls increasing regularly and uniformly in width. Type—*C. Reussi* (Bornemann, 1855), Reuss, 1866; see figs. 12 *a*, 12 *b*.

Cornuspira carbonaria, *Steinmann*, 1880.
— foliacea, *Chapman*, 1891.
— Reussi, *Bornemann*, 1855.
— involvens, *Burbach*, 1886.
— orbicularis, *Mariani*, 1891.
— cretacea, *Chapman*, 1891.
— — *Reuss*, 1860.
Operculina striata, *Czjzek*, 1848.

3. Transverse section of whorls elliptic (with the long axis in the plane of the spire), passing into round or square. Type—*C. polygyra*, Reuss, 1863; see figs. 13 *a*, 13 *b*.

Spirillina tenuissima, *Gümbel*, 1862.
Cornuspira nummulitica, *Gümbel*, 1868.
Operculina perforata, *Costa*, 1856.
Cornuspira angulata, *Deecke*, 1884.
— pachygyra, *Gümbel*, 1869.
— orbicula (*Terquem*), *Deecke*, 1886.
— Archimedis, *Stache*, 1864.
— numismalis (*Terquem and Berthelin*), *Burbach*, 1886.
— elliptica, *Stache*, 1864.
Spirillina numismalis, *Terquem and Berthelin*, 1875.
Cornuspira filiformis, *Reuss*, 1868.
— polygyra, *Reuss*, 1863.
Spirillina regularis, *Terquem*, 1876.
Cornuspira liasina, *Terquem*, 1866.
— pygmæa, *Andreae*, 1884.
— Ammodiscus, or Spirillina, *Wisniowski*, 1888.
— rugulosa, *Reuss*, 1856.

4. Section of whorls crescentic. Type—*C. involvens*, Reuss, 1850; see figs. 11 *a*, 11 *b*.

Cornuspira involvens, *Reuss*, 1850.
— — — 1863.
— — *Jones, Parker, and Brady*, 1866.
— — *Hantken*, 1875.
Spirillina orbicula, *Terquem*, 1875.
Cornuspira polygyra (*Reuss*), *Hantken*, 1875.
Spirillina foliacea (young), *Williamson*, 1857 (fig. 201).
Cornuspira involvens, *Balkwill and Millett*, 1884.
— — *Brady*, 1884.
— — *Brady, Parker, and Jones*, 1888.
— — *Sherborn and Chapman*, 1889.
— Senonica, *Dunikowski*, 1879.
Frumentaria (quartæ specei), *Soldani*, 1780.
Cornuspira ? cretacea, *Burrows, Sherborn, and Bailey*, 1890 (pl. viii, fig. 6).

5. Thick, depressed; section of whorls oblong or elliptic (with the long axis transverse to the spiral plane). Type—*C. angigyra* (Reuss), 1849; see figs. 14 *a*, 14 *b*.

? Cornuspira polygyra, *Reuss*, 1870; *von Schlicht*, 1870, No. 522.
Operculina angigyra, *Reuss*, 1849.

Cornuspiræ with surface-ornamentation.

1. Type—*foliacea*.

CORNUSPIRA STRIOLATA, *Brady*, 1884. 'Challenger' Report, p. 202, pl. cxiii, figs. 18, 19.

In *Operculina plicata*, Czjzek, 1848, 'Haiding. Abhandl.,' vol. ii, p. 146, pl. xiii, figs. 12, 13, the surface-markings seem to be merely lines of *growth*.

2. Type—*Reussi*.

OPERCULINA CARINATA, *Costa*, 1856. Atti Accad. Pontaniana, vol. vii, fasc. 2, pl. xvii, fig. 15.
CORNUSPIRA BORNEMANNI, *Reuss*, 1863. Sitz. k. Akad. Wiss., vol. xlviii, Abth. 1, p. 39, pl. i, fig. 3.
— CARINATA, *Brady*, 1884. 'Challenger' Report, p. 201, pl. xi, fig. 4.
— — *Sherborn and Chapman*, 1889. Journ. R. Micr. Soc. for 1889, p. 484, pl. xi, fig. 6.
— — *Fornasini*, 1893. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iii, p. 431, pl. i, fig. 5.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. II, p. 247, pl. iii, figs. 16, 17.

3. Type—*polygyra*.

CORNUSPIRA CRASSISEPTA, *Brady*, 1884. 'Challenger' Report, p. 202, pl. cxiii, fig. 20.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. II, p. 246, pl. iii, fig. 22.

4. Type—*involvens*.

CORNUSPIRA LACUNOSA, *Brady*, 1884. 'Challenger' Report, p. 202, pl. cxiii, fig. 21.

In the foot-note at page 1 of Part I of this Monograph Reuss's *Cornuspira cretacea* was referred to *Trochammina* perhaps on insufficient grounds. It appears to comprise two, if not three, forms of *Cornuspira*, thus :

1. 1845–6. 'Verst. Böhm. Kreideform.,' p. 33, pl. xiii, figs. 64 and 65, "*Operculina cretacea*" resembles *C. angigyra*, Reuss.

2. 1860. "Sitzungsb. k. Akad. Wiss. Wien,' vol. xl, p. 177, pl. i, fig. 1, "*C. cretacea*" seems to be a crinkled variety of *C. Reussi.*

3. 1863. Ibid., vol. xlvi, p. 34, pl. i, fig. 10, "*C. cretacea*" is equivalent to *C. Reussi*;[1] fig. 11 and fig. 12, var. "*irregularis*," are most likely *Trochammina* and *Ammodiscus*.

The little discoidal forms, in the Gault of Folkestone, which resemble *Cornuspira* are now found by Mr. Chapman to be *Ammodiscus* if examined by transmitted light.

Occurrence.—*Cornuspira foliacea* has a wide range in recent seas, but is more commonly met with in the North Atlantic. The finest specimens have been found at depths ranging from 300 to 600 fathoms. It occurs, however, in shallow waters, and in the deep sea down to 1500 fathoms. The geological range of this species extends (if the published forms are not *Ammodiscus*) from the Gault of Folkestone (Chapman) through the Calcaire Grossier of the Paris Basin, the Oligocene of Germany (Reuss), the Miocene of Vienna (Czjzek), and of Muddy Creek, Victoria (Howchin), the Pliocene of Southern Italy (Costa) and St. Erth (Millett), to the Pleistocene. The Crag specimens were obtained from Sutton only.

Cornuspira involvens is found in all seas, and at depths varying from 7 to 1900 fathoms. It is, however, found but rarely in depths exceeding 700 fathoms. It is specially at home in the north and south temperate and frigid zones. Its geological range equals that of *C. foliacea*, but it has also been recorded from the London Clay (Sherborn and Chapman). In the Crag, in addition to the occurrence already recorded from Sutton, we have found it at Broom Hill and Gedgrave.

Genus 2.—Peneroplis, *de Montfort*, 1808.

Brady, Report '*Challenger*,' *pp.* 62 *and* 203—208.

Part I, 1866, page 17.

General Characters.—Chambers undivided; either plano-spiral throughout, or at first spiral, then rectilinear or cyclical.

[1] And referred by Reuss to the corrugated form, ibid., vol. xl, p. 177, pl. i, fig. 1.

1. Peneroplis planatus (*Fichtel and Moll*). Plate VI, fig. 5.

Part I, 1866, page 19.

Characters.—Of the broad, complanate forms of *Peneroplis*, only one specimen has been met with in the Crag. It is an outspread variety of *P. pertusus*. This individual shows irregularly periodical restrictions in its growth, owing to unfavorable circumstances in its surroundings; but otherwise it is a good representative of *Pl. planatus*. See Brady, Report 'Challenger,' pages 204 and 206, pl. xiii, fig. 15; fig. 5, pl. vi, is equivalent to Carpenter's fig. 1, pl. ii, 'Philos. Trans.,' vol. cxlix, 1859.

Occurrence.—See page 134.

2. Peneroplis (Dendritina) arbuscula (*d'Orbigny*). Plate III, figs. 48, 49.

Part I, 1866, pages 17 and 19; and Appendix II, Table, No. 17.

Characters.—This is one of the medium-sized nautiloid forms of *Peneroplis pertusus* (Forskål), having a dendroid or ramifying orifice. See Brady, Report 'Challenger,' 1884, p. 204. Pl. III, figs. 48, 49, are equivalent to Carpenter's figs. 12 and 16, pl. ii, 'Philos. Trans.,' vol. cxlix, 1859; and, for the aperture, to the woodcuts of *Dendritina*, figs. *a* and *c* at p. 9, and figs. *a*—*d* at p. 11 of the same memoir.

Occurrence.—See page 134.

3. Peneroplis cylindraceus (*Lamarck*). Plate VII, fig. 3.

Part I, 1866 (*Spirolina*), pages 18 and 19; and Appendix II, Table, No. 18.

Characters.—This modification of *Peneroplis* has been known as *Spirolina cylindracea*, and was so described in Part I of this Monograph. Synonyms and some figures are given by Brady, Report 'Challenger,' 1884, p. 205, pl. xiii, figs. 20, 21.

The figure of *P. cylindraceus*, Pl. VII, fig. 3 (lost specimen from the Crag),[1] is from a sketch by the late Dr. H. B. Brady.

[1] See Part I, page 11, foot-note.

Occurrence.—Peneroplis planatus, P. arbuscula, P. cylindraceus. The genus *Peneroplis* has been subdivided in the 'Challenger' Report into seven well-marked groups, having as their types *P. planatus*, *P. pertusus*, *P. arietinus*, *P. cylindraceus*, *P. lituus*, *P. carinatus*, and *P. lævigatus*. Where the genus abounds, specimens of each of these types are to be met with, together with intermediate forms linking the types. This fact is remarkably illustrated by the forms found in the Coralline Crag. Of the three specimens discovered, one is referrible to each of the types *planatus*, *arbuscula*, and *cylindraceus*.

The genus *Peneroplis* is commonly found in the shallow waters of tropical and subtropical seas; but occasional specimens have been taken from depths as great as 435 fathoms. The occurrence of *Peneroplis* as a fossil is somewhat rare. *P. arbuscula* is recorded from the Aquitanian near Bordeaux, and the Miocene of Vienna. *P. planatus* (by d'Orbigny, 'Ann. Sci. Nat.,' vol. vii, 1826, p. 285, No. 1) from the Mediterranean, New Holland, and the island of Rawack; the so-called *Peneroplis* [?] *prisca* (by Reuss, 'Denkschr. k. Ak. Wiss. Wien,' vol. xxiii, 1864, p. 9) from the Nummulitic Formation of Styria; and *P. cylindraceus* from the Miocene of Vienna. The Crag specimens were derived as follows :—*P. planatus* from zone **d**, Broom Hill; *P. arbuscula* from Sudbourne or Gedgrave; and *P. cylindraceus* from Sudbourne.

Genus 3.—Orbiculina, *Lamarck*, 1816.

Brady, Report 'Challenger,' pp. 62 *and* 208.

Part I, 1866, p. 20.

General Characters.—Chambers subdivided by transverse secondary septa; early segments embracing. Planospiral throughout, or partly cyclical; contour nautiloid, crosier-shaped, orbicular, or complanate.

1. Orbiculina adunca (*Fichtel* and *Moll*). Plate III, figs. 43 and 44; Plate VII, fig. 4.
Part I, 1866, pp. 20 (*O. adunca*) and 21 (*O. compressa*); and Appendix II, Table, Nos. 19, 20.

Characters.—Fig. 43 is an adult individual in which the initial spiral portion of the shell is quite obscured, having been completely and symmetrically surrounded

by successive concentric *annuli* of chambers. D'Orbigny's fig. 4 (*O. compressa*), pl. viii, ' Foram. Cuba,' illustrates an analogous discoidal specimen; and his fig. 5 is one which retains evidence of the central spire, just as is also seen in Brady's fig. 9, pl. xiv, Report ' Challenger.' Fig. 43 is equivalent to Carpenter's fig. 11, pl. xxviii, ' Phil. Trans.,' vol. cxlvi, 1856. Fig. 44 is an approximately adult individual of this variable form, which changes much as to details in closing up its subdiscoidal shell by the meeting and coalescence of the newest marginal chambers. This specimen stands close to such forms as are represented by figs. 7 and 8 in pl. xiv, Report ' Challenger,' and described by Brady at p. 209; and is equivalent to Carpenter's fig. 4, pl. xxviii, ' Philos. Trans.,' vol. cxlvi, 1856. Fig. 44 is the specimen P. 3094 in the British Museum. Pl. vii, fig. 4, is a broken specimen from Sutton, which evidently had much more of the spire exposed than the specimen illustrated by pl. iii, fig. 44, and in this respect it has a relationship with *Peneroplis* (?) *prisca*, Reuss (' Denksch. k. Akad. Wien,' vol. xxiii, 1864, p. 9, pl. i, fig. 7), from the Eocene of Styria. The shape of the chamberlets, which are worn open in our fig. 44 and fig. 4, is like that of *Orbitolites tenuissimus*, Carpenter; but this is evidently a modification of the shorter chamberlets in fig. 43, and need not be mistaken for the externally striate structure of *Peneroplis*.[1]

Occurrence.—Orbiculina adunca is essentially a tropical form. It frequents shallow waters, and the greatest depth at which it has been found is 450 fathoms. As a fossil it is rare, and has been recorded with certainty only from the Miocene of Vienna. In the Coralline Crag the true *adunca* has been found at Sutton, zone **e**. The specimens of the complanate variety, Pl. III, fig. 43, were also obtained from Sutton.

[1] Commenting on the absence of rigidity in adherence to a type-form, which has been noticed in the genera and species of the Foraminifera by many observers, Dr. A. Goës remarks (in a letter), "If we take, for instance, *Peneroplis* and *Orbitolites* we see a constant oscillation going on between the two forms *per medium* of *Orbiculina,—Orbitolites* breeding its own form, also *Orbiculina*, and perhaps also *Peneroplis*." In the progress (with atavism) to a higher type, the primal form becomes "a larval stage to the latter until it becomes reduced to a single embryonal chamber, and the new type is ready. The same with *Miliolina*, *Globigerina*, *Uvigerina*, *Cristellaria*, *Frondicularia*, *Textilaria*, &c. This oscillation is best seen in *Orbiculina*, because there the primal type and the final type are included in the same shell. We thus see that many of our ' genera ' and ' species ' are not founded on natural principles."

Genus 4.—Orbitolites, *Lamarck*, 1801.

Brady, Report 'Challenger,' pp. 62 *and* 210.

Part I, 1866, page 22.

General Characters.—Discoid; commencement either spiral and non-embracing or with one or more inflated chambers, then cyclical; chambers divided into chamberlets.

1. Orbitolites complanatus, *Lamarck*. Plate III, figs. 45—47 (*O. orbiculus*).

Part I, 1866 (*O. orbiculus*), page 23; and Appendix II, Table, No. 21.

Additional Synonyms:

Orbitolites complanatus, &c., *Carpenter*, 1883. Report 'Challenger,' xxi, pp. 1—49, pl. i—viii; Philos. Trans., 1883, p. 562, figs. 4 & 5; Journ. Quekett Microsc. Club, ser. 2, vol. ii, 1885, p. 91, &c. (figs.).
— — *Brady*, 1884. Report 'Challenger,' Zool., vol. ix, p. 218, pl. xvi, figs. 1—6; pl. xvii, figs. 1—6.

Characters.—In Part I this Foraminifer was treated under the name of *Orbitolites orbiculus*, derived from the "*Nautilus orbiculus*" described by Forskål as a white orbicular organism, flat on both sides (faces), marked with subconcentric bead-like, spiral lines, and having all the outer margin perforated with double pores. In his Report 'Challenger' (1884) Brady has ignored this name, without any explanation. Perhaps he preferred the alternative offered by Parker and Jones in the 'Annals Mag. Nat. Hist.,' ser. 3, vol. viii, 1861, p. 235, and thus regarded it as an adult *Orbiculina adunca* (like fig. 43, Pl. III, see above, page 134); and perhaps in his opinion Forskål's allusion to its likeness to "*Nummulites placentula*," probably his "*N. major*" (now known as *N. complanatus*), may have made the proposed synonymy less likely. Carpenter also missed this name; and with others he made Lamarck's name, "*O. complanatus*," so common that we are inclined to allow the doubtfulness of Forskål's specimen, and to let his be merged in Lamarck's better known name.

Occurrence.—Orbitolites complanatus is at home in the shallow waters of tropical and subtropical seas, particularly among the coral reefs of the North and South Pacific and the Indian Ocean. Fossil specimens of this species are particularly abundant and very finely developed in the Calcaire Grossier of the Paris Basin. Specimens are also recorded from the Eocene of Belgium and the Bracklesham Beds; and from the Miocene of Malta (Brady), and of Muddy Creek, Victoria. The Crag examples were obtained from Sutton, and probably were derived from some older Tertiary beds.

Sub-family 4.—ALVEOLININÆ.

Spiral, elongate in the axis of convolution; chambers subdivided.

Genus 1.—ALVEOLINA, *d'Orbigny*, 1826.

Brady, Report 'Challenger,' 1884, *pp.* 62 *and* 221.

General Characters.—Subglobular, elliptic, or fusiform. Recent forms often with subdivided chamberlets.

1. ALVEOLINA, sp. Woodcut, fig. 10.

Part I, 1866, page 24; and Appendix II, Table, No. 22.

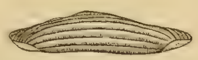


FIG. 16.—*Alveolina Boscii* (Defrance) × 7½. After Brady, Report 'Challenger,' pl. xvii, fig. 9.

One or two lost specimens, which had been collected at Sudbourne by Mr. S. V. Wood, but much worn and indeterminate, were mentioned at page 24. They were probably derivatives from some older Tertiary formation.

Occurrence.—Alveolina Boscii is a shallow-water form, and is confined to warm latitudes. It is of common occurrence among coral reefs at depths of twenty or thirty fathoms. This species is a very common fossil in the Eocene of the Paris Basin, and in the Bracklesham Beds of Sussex. The Crag specimens were, in all probability, derived from an older formation.

II. ARENACEA.

General Characters.—Shells made of sand-grains and other materials, agglutinated together by ferruginous, calcareous, chitinous, or siliceous cement; some, such as *Textilaria* and *Bulimina*, are hyaline, and others porcellaneous or chitinous, in an early stage. Many are sandy isomorphs of porcellaneous and hyaline types.

Family 1.—LITUOLIDÆ.

General Characters.—Of the *Lituolidæ* there are few representatives among the Foraminifera collected from the Crag. In this family the test is arenaceous, usually regular in contour. The septation of the polythalamous forms is often imperfect; chambers often labyrinthic.

Sub-family 1.—Lituolinæ.

General Characters.—Test made of coarse sand-grains; rough externally, often labyrinthic internally.

Genus 1.—Haplophragmium, *Reuss*, 1860.

Brady, Report 'Challenger,' pp. 65 *and* 300.

General Characters.—Test free; made of coarse sand-grains; partly or entirely spiral; nautiloid or crozier-shaped; chambers simple.

1. Haplophragmium glomeratum (*Brady*). Plate V, fig. 12.

Lituola glomerata, *Brady*, 1878. Ann. Mag. N. H., ser. 5, vol. i, p. 433, pl. xx, fig. 1.
Haplophragmium glomeratum, *Wright*, 1881. Proc. Belfast Nat. H. Club, Append., pl. viii, fig. 1.
— — *Brady*, 1882. Denks. k. Akad. Wien, vol. xliii, p. 100.

Haplophragmium glomeratum, *Brady*, 1884. Rep. 'Challenger,' p. 309, pl. xxxiv, figs. 15—18.
— — *Balkwill and Millett*, 1884. Journ. Micr. Nat. Sci., vol. iii, p. 25, pl. i, fig. 6.
— — *Chapman*, 1892. Journ. R. Micr. Soc., p. 321, pl. v, fig. 8.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 23, pl. v, figs. 134—139.

Characters.—Spiral, subglobular; segments few, three or four in the outer whorl.

Occurrence.—This species has a wide geographical range. It is common in Arctic and Antarctic seas at moderate depths (14 to 200 fathoms). In tropical and subtropical seas it is found at greater depths. As a fossil it was first recorded by Mr. Chapman from the Gault of Folkestone, where it is rather common. We have found the form that is here figured in nearly every zone of the Crag examined. It is common at Sudbourne Hall, zone **d**, and at Aldborough, zone **g**.

Note.—There is much doubt as to this being *Haplophragmium glomeratum*. It may well be the young (initial) form of *Textilaria gibbosa*. This supposition is borne out by the fact that wherever *T. gibbosa* is common, the small form here referred to *H. glomeratum* is also plentiful. Arenaceous species, besides *Textilaria*, are, as a rule, very rare in the Crag.

Sub-family 2.—Trochammininæ.

Brady, Report 'Challenger,' 1884, pp. 66 *and* 321.

General Characters.—Test thin, consisting of minute sand-grains incorporated with calcareous or other inorganic cement, or embedded in a chitinous membrane; exterior smooth, often polished; interior smooth, often reticulate, not labyrinthic.

Trochammina, Jones and Parker, 1859 (see Part I, 1886, pp. 25—27).—More or less septate; rotaliform, trochoid, or irregular.

Ammodiscus, Reuss, 1861 (divided off from the foregoing).—Non-septate and tubular; spiral or irregular.

Genus 1.—Webbina, *d'Orbigny*, 1839.

Brady, Report 'Challenger,' pp. 66 *and* 348.

General Characters.—Adherent; single tent-like chamber, or a series, connected by semi-tubular stoloniferous passages.

1. Webbina hemisphærica, *Jones, Parker, and Brady.* Plate IV, fig. 5.

Part I, 1866, p. 27; Appendix II, Table, No. 23.

Webbina hemisphærica, *J., P., and B.*, 1866.			Monogr. Foram. Crag, p. 27, pl. iv, fig. 5.
—	—	*Brady*, 1884.	Report 'Challenger,' p. 350, pl. xli, fig. 11.
—	—	*Egger*, 1893.	Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. 2, p. 226, pl. xiv, figs. 1—3.

This form, represented in 1866 by one specimen from the Crag of Sutton, was regarded as variety *hemisphærica* of *Webbina irregularis*, d'Orb., which Parker and Jones looked upon as belonging to a sub-type of their *Trochammina*, which also comprised some forms since referred to *Ammodiscus*.

Occurrence.—*Webbina hemisphærica*, first described in the First Part of this Monograph, has since then been found in the living state in shallow water (twenty-five to thirty-three fathoms) at two points off the coast of Durham, by G. S. Brady and D. Robertson ('Report Brit. Assoc.' for 1875, pp. 188, 189); and by the 'Gazelle' at 69 metres off the Cape-Verd Islands. The Crag specimen was obtained from Sutton.

It may be mentioned that the specimens which have been recorded as *Webbina* from the Lias probably belong to *Nubecularia*.

Note.—In Part I (1866) the *Lagenidæ* followed here, but it is now more convenient to take in order others of the arenaceous group, so called, although they are hyaline when young.

Family 2.—TEXTILARIIDÆ.[1]

Brady, Report 'Challenger,' 1884, pp. 67 *and* 354.

General Characters.—Tests of the larger forms arenaceous, either with or without a perforate calcareous basis; small forms hyaline and perforate. Chambers arranged in two or more alternating series, or spiral, or confused; often dimorphous, comprising the *Textilariinæ* and *Bulimininæ*.

[1] The genera *Textilaria, Bulimina,* and *Cassidulina* were placed in the midst of the Hyaline Foraminifera in Part I of this Monograph,—see the tables in the Appendices I and II. As their shell is "perforate," and as its sandy condition is not present in all the forms, and therefore is not an essential feature, *Textilaria* and *Bulimina* are in this respect intermediate to the Arenaceous and Hyaline groups, and (with their Hyaline sub-genera) may be placed last in order among the former, or first among the latter, thus coming between the *Lituolidæ* and the *Lagenidæ*.

Sub-family 1.—Textilariinæ.

General Characters.—Typically bi- or tri-serial; often bi-, sometimes trimorphous.

Genus 1.—Textilaria, Defrance (*Textularia*), 1824.

Brady, Report 'Challenger,' 1884, *p.* 356.

Synonyms of Textilaria :[1]

Polymorphum, *Soldani.*
Nautilus, *Soldani, Batsch.*
Grammostomum, in part.
Clidostomum ?
Guttulina, in part.
Proroporus, in part.
Polymorphina, in part.
Heterostomum.
Rhynchoplecta ?
Rhynchopleura ?
— *Ehrenberg.* (For notices of various forms figured by Ehrenberg, that probably come under *Textilaria sagittula*, d'Orb., see the 'Annals and Mag. Nat. Hist.,' ser. 4, vol. x, 1872, pp. 284, 286, 287, 288, 290, and 456.)
Cribrostomum, in part, *Möller.*
See also the foot-note.

General Characters.—Shell free, regular, and equilateral; conical, pyramidal, pyriform, cuneiform, or oblong. Segments numerous, arranged in two alternate parallel series. Septal orifice at the centre of the umbilical margin of the segment close to its line of contact with the preceding and opposite segment.

[1] The name *Textilaria*, used by Ehrenberg, 1839, is here adopted in accordance with the recommendation in the 'Rules for Zoological Nomenclature (No. 14), Brit. Assoc.,' that Latin orthography should be adhered to. From Mr. C. D. Sherborn's printed and manuscript bibliographies of Foraminifera we are able to state that more than twenty-five authors have adopted *Textilaria*, and upwards of eighty-five have used "*Textularia*," as shown in the following list:

1. Textilaria.—Ehrenberg, Bronn, von Reuss, Phillips, Schultze, Terquem, Stache, Karrer, von Hantken, von Gümbel, Schwager, Kübler, Zwingli, Berthelin, von Schlicht, de Folin, Moebius, Schlumberger, Uhlig, Andreæ, Hoernes, Deecke, Neumayr, Beissel, Holzapfel, and others.

2. Textularia.—Defrance, d'Orbigny, Nilsson, Roemer, Michelotti, von Hagenow, Macgillivray, Bailey, Williamson, Cornuel, Czjzek, Alth, Costa, Egger, Jones, Parker, Brady, Carpenter, Pictet, Seguenza, Alcock, Sars, Fischer, Pourtales, Greene, G. M. Dawson, J. W. Dawson, Norman, Siddall, Vine, Bütschli, Terrigi, Goës, Fornasini, Woodward and Thomas, Wright, Balkwill, Millett, Sherborn, Chapman, Malagoli, Burrows, A. Agassiz, Dervieux, Guppy, de Amicis, and others.

The *Textilariæ* are so very variable in their growth, forming vesicular, quadrate, or flattened chambers, and arranging them sometimes quite regularly and at other times with a want of neatness, that there may be almost as many names for them as there are groups of more or less similar individuals.

Specimens having sandy shell-tissue were grouped as *Plecanium* by von Reuss ('Sitzungsb. k. Akad. Wiss. Wien,' vol. xliv, 1861, p. 383).

1. TEXTILARIA SAGITTULA, *Defrance*, 1824. Plate III, figs. 7—9; Plate V, figs. 15, 16, 18.

Part I, 1866, Appendix II, Table, No. 64.

Polymorpha sagittulæ, *Soldani*, 1791. Testac., vol. i, part 2, p. 120, pl. cxxxiii.

The figures given by Soldani are rough and obscure, but figs. O, P, Q, R, T, V, may be equivalent to various forms of *T. sagittula*. Fig. S appears to be *T. jugosa*, Brady.

TEXTULARIA SAGITTULA, *Defrance*, 1824. Dict. Sci. Nat., vol. xxxii, p. 177; vol. liii, p. 344; Atlas Conch., pl. xiii, fig. 5.
— — *Blainville*, 1825. Malacologie, p. 370, pl. v, fig. 5.
— — *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 263, No. 20.
— SAULCYANA, *Idem*, 1839. Foram. Cuba, p. 142, pl. i, figs. 21, 22.
— CUNEIFORMIS, *Idem*, 1839. Ibid., p. 138, pl. i, figs. 37, 38.
— BAUDOUINANA, *d'Orb.*, 1840. Mém. Soc. Géol. France, vol. iv, Mém. No. 1, p, 46, pl. iv, figs. 29, 30.
— SAGITTULA, *Reuss*, 1846. In Geinitz's Grundriss, &c., part 2, p. 680, pl. xxiv, fig. 72.
— NUSSDORFENSIS, *Idem*, 1846. Foram. Foss. Vienne, p. 243, pl. xiv, figs. 17—19.
— BRONNIANA, *Idem*, 1846. Ibid., p. 244, pl. xiv, figs. 20—22.
— DEPERDITA, *Idem*, 1846. Ibid., figs. 23—25.
— PALA, *Czjzek*, 1848. Haidingers Nat. Abbandl., vol. ii, p. 148, pl. xiii, figs. 25—27.
— PRÆLONGA, *Idem*, 1848. Ibid., p. 149, pl. xiii, figs. 28—30.
— ACUTA, *Reuss*, 1850. Denksch. k. Akad. Wien, vol. i, p. 381, pl. xlix, fig. 1; 1855, in Quenstedt's Handb. Petref., edit. 3 (5), p. 1059, pl. lxxxvi, fig. 60.
— sp., *Mantell*, 1850. Q. J. G. S., vol. vi, p. 330, pl. xxix, fig. 1.
— MUTATA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, pl. xxiii, fig. 19, and indet., fig. 20.
— CUNEIFORMIS, *Williamson*, 1858. Rec. Foram. Brit., p. 75, pl. vi, figs. 158, 159.
— SAGITTULA, *P. and J.*, 1863. Ann. Mag. N. H., ser. 3, vol. xi, p. 96.

TEXTULARIA AGGLUTINANS, var. SAGITTULA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 369, pl. xvii, figs. 77 *a, b*.

— SAGITTULA, *J., P., and B.*, 1866. Monogr. Foram. Crag, Append. II, Table, No. 64.

PLECANIUM LYTHOSTROTUM, *Schwager*, 1866. Novara-Exped. Geol. Theil, vol. ii, p. 194, pl. iv, figs. 4 *a—c*.

— SOLITUM, *Idem*, 1866. Ibid., p. 195, pl. iv, figs. 6 *a—c*.

TEXTILARIA ALPINA, *Kübler and Zwingli*, 1866. Neujahrsblatt Winterthur, p. 19, pl. iii, figs. 11 and 19.

TEXTULARIA SAGITTULA, *Brady and Robertson*, 1870. A. M. N. H., ser. 4, vol. vi, pp. 299, 306.

— — *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, p. 168, pl. xi, fig. 114.

— — *Brady and Robertson*, 1875. Report Brit. Assoc, p. 190.

TEXTILARIA CUNEIFORMIS *Terquem*, 1881. Foram. Dunkerque, fasc. iii, p. 129, pl. xvii, figs. 2 *a, b*.

— DEPERDITA, *Schlumberger*, 1882. Feuil. Jeun. Nat., pl. ii, fig. 1.

TEXTULARIA SAGITTULA, *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, p. 72, pl. v, figs. 133—136 [var.], 144—146, 147—149 [var.], 150 and 151 [var.].

— — *Brady*, 1884. Report 'Challenger,' p. 361, pl. xlii, figs. 17, 18.

— — *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci.), p. 332, pl. xiii, figs. 15—17 (fig. 15 partly = *pectinata*, Reuss).

— — (after *Soldani*), *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 116 and 277—279.

— — *Fornasini*, 1887. Ibid., vol. vi, pp. 394, 395.

— — *Idem*, 1888. Ibid., vol. vii, p. 46, pl. iii, figs. 2—4.

— — *Malagoli*, 1887. Ibid., vol. vi, p. 520, pl. xiii, fig. 1.

— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, No. 1, p. 219, pl. xlii, figs. 1 *a, b*.

— — *Agassiz*, 1888. Cruises of the 'Blake,' vol. ii, p. 164, fig. 500.

— — *Haeusler*, 1890. Abhandl. Schweiz. Pal. Ges., vol. xvii, p. 70, pl. xi, figs. 20—25, and 38.

— — *Chapman*, 1892. Journ. Microsc. Soc. for 1892, p. 328, fig. 16, roundish edges.

— — *Egger*, 1893. Abhandl. Akad. Bayer., vol. xxviii, part 2, pp. 268 and 271, pl. vi, figs. 8—10 (chambers more gibbose than usual).

— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 41, 180, 181.

— — *Idem*, 1893. Ibid., vol. xii, p. 331.

— cf. CONICA, *d'Orb., Idem.* Ibid., p. 339, pl. iii, fig. 6.

TEXTULARIA SAGITTULA, var. CUNEIFORMIS, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 36, pl. vii, figs. 288—290.
— WILLIAMSONI, *Goës*, 1894. Ibid., p. 36, pl. vii, figs. 285—287.

Characters.—Shell compressed, cuneiform, thickest along the centre. Margins thin, sometimes carinate. Segments numerous, narrow, more or less horizontal; usually those near the top, but sometimes those nearest the middle, are the longest. Sutures slightly constricted. Texture sub-arenaceous.

The spathulate, narrow-chambered, thin-edged *Textilariæ*, which find their best representative form in *T. sagittula*, Defrance, constitute the commonest and most widely distributed section of the genus. They seldom attain the dimensions of average specimens of *T. gibbosa* or *T. agglutinans*, nor do they usually present so rough an exterior; but, on the other hand, they are larger and more stoutly built than such forms as *T. pygmæa* or *T. variabilis*.

The contour of the shell is very well described by Prof. Williamson, under the head *Textularia cuneiformis, typica*, who notes the rapid increase in the size of the earlier segments, which imparts to young specimens their triangular form, and the subsequent regularity and evenness in length of the chambers, frequently decreasing rather than increasing in dimensions from the middle of the shell. Sometimes, as in the specimen figured by d'Orbigny from the Canaries, the sutures are limbate.

Pl. III, figs. 7—9, are ordinary forms with straight chambers and sharp edges. Pl. V, fig. 15, has widened out more rapidly than usual, and the terminal chamber has grown out of place, with a tendency to linear growth. Fig. 16 has its chambers less symmetrically arranged than in the type-form. Fig. 18 is symmetrical and longer than usual, but slightly flexed, as in many other instances. Fig. 19 will be referred to as var. *jugosa* (Brady). Fig. 20 is a short, strong, broad variety (*sulcata*), in which the inner part of each chamber protrudes outward, either close to the median junction (as on one side), or a little way from it (on the other), leaving a depressed channel along the middle of the shell. As it is the upper edge of the chamber (on one side) that thickens to produce this feature, this variety is related to that shown by fig. 19. Fig. 21 is a small specimen, either young or a dwarf form, probably the latter, and is referred to further on (*Flabelliformis*).

It may be remarked that *Text. Jonesi*, Brady, 'Monogr. Carb. Perm. Foram., Pal. Soc.,' 1876, p. 133, pl. x, figs. 20—22, are broad, flat, palæozoic forms of *T. sagittula;* and that *T. anceps*, Reuss, 'Böhm. Kreid.,' 1845, vol. i, p. 39, pl. viii, fig. 78, and pl. xiii, fig. 78; and 'Sitz. Ak. Wien,' vol. xl, 1860, p. 234, pl. xiii, fig. 2, is very near to the same species, although its chambers are not horizontal, but somewhat inclined (still more sloping in *T. aciculata* and *pygmæa*). In Terrigi's figs. 24—27,

pl. ii, 'Atti Accad. Pontif. Lincei,' vol. xxxiii, 1880, p. 69, passages from *T. aciculata* towards *sagittula* are well shown.

T. obsoleta, Reuss, 'Böhm. Kreid.,' l. c., fig. 79, is a rather thick form of *sagittula*. *T. Partschii* as there figured only differs by its rounded edges; figured elsewhere by Czjzek (1848, 'Haiding. Abh.,' vol. ii, pl. xiii, figs. 28—30), it is equivalent to *gibbosa* with horizontal chambers; and *prælonga*, ibid., is a long narrow *sagittula*.

Plecanium lanceolatum, Karrer, 'Sitz. Akad. Wien,' vol. lvii, 1868, p. 129, pl. i, fig. 2, is an elongate *sagittula*, which loses its sharp edges in the upper part, where the chambers become rather thick and squarish, as in Reuss's figure of *T. Partschii*.

So also *Text. luculenta*, Brady, var. *Calaritana*, Fornasini ('Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 389, pl. x, figs. 3—3 *b*), begins as *sagittula*, and grows up with thicker, more inclined, and less regular chambers. The variety has sharp edges and more inclined chambers, set more loosely together than Brady's figs. 5—8, pl. xliii, p. 364, Report 'Challenger.'

T. Baudouinana, d'Orb., from the Chalk ('Geologist,' 1863, p. 294, pl. xv, fig. 6), is symmetrical in outline and in the setting-on of its depressed or narrow chambers; it can scarcely, if at all, be distinguished from a well-grown *T. sagittula*. D'Orbigny states that it is near to *T. communis*, d'Orb, 'Ann. Sci. Nat.,' vol. vii, 1826, p. 263, No. 27.

Occurrence.—*Textilaria sagittula* is of very common occurrence in the shallow waters of temperate seas, and has a very wide geographical range. Specimens have been found at depths of 2675 fathoms in the North Atlantic, and at 1425 fathoms in the South Atlantic. Geologically also *T. sagittula* is of very frequent occurrence. The records at present appear to be from the Neocomian (Bargate Beds) of Surrey (Chapman); the Gault of Folkestone (Chapman); throughout the Chalk; Eocene (London Clay); Miocene of Vienna, of Muddy Creek, and elsewhere; Pliocene of Italy, Garrucha, and St. Erth; and from several Post-Tertiary deposits. In the Coralline Crag we have found it, with varying frequency, in every zone examined, and it is the only species of *Textilaria* recorded from the Red Crag.

1*. Textilaria sagittula, *Defrance*, var. jugosa (*Brady*). Plate V, fig. 19.

Polymorpha sagittulæ, *Soldani*, 1791. Testac., &c., vol. i, part 2, p. 120, pl. cxxxiii, fig. *s*.
Textularia sagittula, *d'Orb.*, 1839. Foram. Canaries, p. 138, pl. i, figs. 19—21.
— — *Reeve*, 1842. Conch. Syst., vol. ii, p. 292, pl. ccvii, fig. 10.

TEXTULARIA SAGITTULA, *Costa*, 1856. Atti Accad. Ponton., vol. vii, p. 291, pl. xxiii, fig. 11.
— JUGOSA, *Brady*, 1884. Report 'Challenger,' p. 258, pl. xlii, figs. 7 *a*, *b*.
— SAGITTULA, *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 374, pl. ix, figs. 1, 2.
— — *Idem*, 1888. Ibid., vol. vii, p. 46, pl. iii, figs. 2—4.
— JUGOSA, *Egger*, 1893. Abhandl. k. Ak. Bayer., vol. xxviii, part 2, p. 273, pl. vi, figs. 19—21 (of rather irregular growth).

This variety of *T. sagittula* has the sutures limbate, either being thickened and swollen with an exogenous deposit of shell-substance, or overlapped by the extra shell-substance at the top edge of each chamber. Another limbate variety is the *T. flabelliformis*, Gümbel, noticed at page 147; and Fornasini's "forma abbreviata" of *T. sagittula*, 'Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 400, pl. i, fig. 2.

Occurrence.—*Textilaria sagittula*, var. *jugosa*, has been found in the living state in considerable numbers in the shore sand on the east coast of Madagascar. Specimens were also found, but of diminutive size, by the 'Challenger' off Raine Island, Torres Strait, at a depth of 155 fathoms; and by the 'Gazelle' off the north-west coast of Australia. The Gulf of Suez (15 to 20 fathoms) is another locality whence specimens have been obtained. The Crag specimen is in Mr. F. Chapman's Collection, and was probably from Sutton; this is the first record of the variety in a fossil condition.

2. TEXTILARIA SULCATA, sp. nov. Plate V, fig. 20.

Characters.—Shell short, triangular in outline, compressed, chambers horizontal, with sharp lateral edges. A broad furrow with unequal sides marks the median line where the chambers meet. This is due to a partial thickening, or limbation, of the inner angle of the upper margin of the chambers (after the early growth of the shell) on one side, and by a succession of protuberances on the chambers of the other side.

The local thickening of the margins of the chambers near the median line of junction is evidently analogous to, if not identical with, that in fig. 19, although not of equal intensity.

Occurrence.—The Crag specimen of *Textilaria sulcata*, figured Pl. V, fig. 20, is in the Searles-Wood Collection in the British Museum, and was probably obtained from Sutton. We have this species from the Miocene of Muddy Creek, Victoria, although it is not recorded nor figured in Mr. Howchin's paper on the Foraminifera of that locality ('Trans. Roy. Soc. S. Australia,' vol. xii, 1889).

3. TEXTILARIA SUBFLABELLIFORMIS, *Hantken*, 1875. Plate V, fig. 21.

TEXTILARIA SUBFLABELLIFORMIS, *Hantken*, 1875 (1881). Mitth. Jahrb. Ung. Geol. Anstalt, vol. iv, p. 66, pl. xv, fig. 2.

This form is closely allied to *T. sagittula*, but shorter and broader. Von Hantken's illustration (fig. 2) is a good counterpart of our fig. 21. Fornasini figures the nearly allied *T. unita*, 'Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 397, pl. x, figs. 2, 2 *a*, 2 *b*, differing from our specimen in being larger, thicker, and narrower, and therefore less broadly triangular. Both of these have the style of growth of *T. sagittula* as to the setting-on of the chambers, which are nearly horizontal and compact; but extending laterally they give a greater breadth to the shell. This form is short in growth, and whether it be young or dwarf is doubtful.

Textilaria flabelliformis, Gümbel, 1868, 'Abhandl. Akad. Bayer.,' vol. x, p. 647, pl. ii, figs. 83 *a*, *b*, having limbate sutures, is analogous, in this respect, to the var. *jugosa* of *T. sagittula*. It is otherwise similar to von Hantken's fig. 2, except that its chambers are curved. Fornasini, in the 'Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 400, pl. xi, figs. 2, 2 *a*, has illustrated a "short form of *T. sagittula*," which has the upper edges of the chambers thickened so as to form a limbation, as in var. *jugosa*. Except for this feature it would be *subflabelliformis*.

Occurrence.—The specimen of *Textilaria subflabelliformis*, Pl. V, fig. 21, is in the Searles-Wood Collection in the British Museum, and was probably obtained from Sutton. We have not noted its occurrence in other exposures of the Coralline Crag.

4. TEXTILARIA AGGLUTINANS, *d'Orbigny*, 1839. Plate III, figs. 14—16.

Part I, 1866, Appendix II, Table, No. 61.

TEXTULARIA AGGLUTINANS, *d'Orb.*, 1839. Foram. Cuba, p. 144, pl. i, figs. 17, 18, and figs. 32—34.
TEXTILARIA PARALLELA, *Reuss*, 1860. Sitzungsb. k. Akad. Wien, vol. xl, p. 233, pl. xii, figs. 7 *a*, *b*.
— CONCINNA, *Reuss*, 1860. Ibid., vol. xl, p. 233, pl. xiii, figs. 1 *a*, *b*.
— CONULUS, *Reuss*, 1860. Ibid., vol. xl, p. 231, pl. xiii, figs. 3 *a*, *b* (short form of *T. agglutinans*).

TEXTILARIA PUPA, *Reuss*, 1860. Sitzung. k. Akad. Wien, vol. xl, p. 232, pl. xiii, figs. 4 *a*, *b*, and 5 *a*, *b* (shortest form).

— PARTSCHII, *Reuss*, 1860. Ibid., vol. xl, p. 233, pl. xiii, figs. 6 *a*, *b*.

— — *Seguenza*, 1862. Atti Accad. Gioenia, ser. 2, vol. xviii, p. 114, pl. ii, figs. 4, 4 *a*.

— AGGLUTINANS, *Parker and Jones*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xi, pp. 91, 93, and 97.

— — var., *Jones*, 1863. Geologist, vol. vi, p. 294, pl. xv, figs. 4, 5. (Having subglobose chambers more loosely arranged than in the type, and fig. 5 is flexed.)

PLECANIUM STURI, *Karrer*, 1864. Sitzungsb. k. Akad. Wien, vol. i, p. 703, pl. i, fig. 1.

TEXTULARIA AGGLUTINANS, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 369, pl. xv, figs. 21 *a*, *b*. (A thick, blunt form.)

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Tables, Appendices I and II.

PLECANIUM AGGLUTINANS, *Reuss*, 1869. Sitzungsb. k. Akad. Wien, vol. lix, p. 452, pl. i, figs. 1 and 2.

TEXTILARIA AGGLUTINANS, *Moebius*, 1880. Foram. Mauritius, p. 93, pl. ix, figs. 1—8. (Structure well described.)

TEXTULARIA AGGLUTINANS, *Hamilton*, 1881. Transact. New-Zealand Institute, vol. xiii, p. 395, pl. xvi, fig. 10.

— — *Brady*, 1884. Report 'Challenger,' p. 363, pl. xliii, figs. 1—3; and var., figs. 4 and 12.

— — *Woodward and Thomas*, 1884. 13th Report Geol. N. H. Surv. Minnesota, p. 167, pl. iii, figs. 6 and 7.

— — *Vine*, 1885. Proc. Yorksh. Geol. Soc., N. S., vol. ix, No. 1, p. 28, pl. ii, fig. 17.

— — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 742, pl. xiv, figs. 6 *a*, *b*.

— — ? *Malagoli*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 520, pl. xiii, fig. 2.

— — *Toutkowsky*, 1888. Zapisk. Kievsk., vol. ix, p. 9, pl. ix, figs. 3 *a*—*c*.

— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, No. 7, p. 219, pl. xli, figs. 17 and 23; pl. xlii, figs. 2 and 3.

— — *Haeusler*, 1890. Abhandl. Schweiz. Paläont. Ges., vol. xvii, p. 71, pl. xi, figs. 1—9, 11—16, 47—50, and 52. (Including some modifications.)

— — *Chapman*, 1892. Journ. R. Microsc. Soc., p. 329, pl. vi, fig. 21.

TEXTULARIA AGGLUTINANS, *Egger*, 1893. Abhandl. k. Akad. Bayer., vol. xxviii, part 2, p. 267, pl. vi, figs. 1 and 2. (Thick, trochoid.)

— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 35, pl. vii, figs. 281—284, 294—303. (Fig. 300 seems to be typical, the others varieties.)

Characters.—Shell elongate, conical, suboblong in section; chambers more or less horizontal and compact, presenting a broad or narrow pentagonal aspect on the sides of the shell. The chamber-cavities liable to subdivision by secondary septa (see fig. 16), which form barred apertures. Shell-wall consisting of agglutinated sand-grains.

This form, which we regard as the type of the genus, is variable in its features to a considerable extent. Extreme forms are illustrated by the tapering and slightly flexed fig. 14 of Pl. III; the short subcylindrical form in the 'Phil. Trans.,' 1865, pl. xv, fig. 21; and the longer subcylindrical *T. parallela*, Reuss; the compressed *T. lævigata*, d'Orb., and *T. concinna*, Reuss, and the shorter *T. conica* and *pupa*, passing into *T. Partschii*, which is evidently related to *T. gibbosa* and *tuberosa*, d'Orb. On the other hand, *T. agglutinans* may be compressed, as *Plecanium eocænum*, Gümbel.

D'Orbigny's figures, from recent examples, very much resemble our Pl. III, figs. 14, 15, the latter being perhaps a little rougher and more irregular; but proportionately shorter specimens are often met with. The labyrinthic condition shown in section in fig. 16 is not uncommon in other varieties of the genus, under circumstances favorable to the production of large free-growing specimens. A similar state of the terminal orifice is one of the peculiar characters of the tropical *Textilaria Barrettii.*

Occurrence.—*Textilaria agglutinans* is found in all seas and at all depths; the lowest recorded depth is 3125 fathoms. The geological range of this species has lately been shown to extend from the Neocomian (Bargate Beds) of Surrey (Chapman). It has been found also in the Gault of Folkestone, the Red Chalk of Speeton, the White Chalk, the Eocene London Clay, the Oligocene of Elsass, the Miocene of Vienna and of Muddy Creek in Victoria, the Older Tertiaries of South Australia (Howchin), the Helvetian and Plaisancian beds of Italy (de Amicis), and in the Pleistocene of Sicily (Seguenza). We have found specimens in every zone of the Coralline Crag examined except at Tattingstone. In Mr. S. V. Wood's Sutton gatherings the specimens are numerous and large.

4*. Textilaria agglutinans, *d'Orb.*, Var. densa, nov. Plate VI, figs. 17 *a*, *b*.

Textularia agglutinans, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 369, pl. xv, fig. 21.

Characters.—Shell subcylindrical, thick, tapering to the blunt aboral apex; somewhat compressed, and with the transverse section ovate; chambers numerous, compact, narrow in side view, and horizontal.

This belongs to the *agglutinans* type, as represented by the thick Arctic form figured in the 'Phil. Trans.,' 1865, pl. xv, fig. 21, which, however, is relatively smaller, rather more compressed, and tapers more rapidly to the apex, having widened more rapidly in growth. Both of these forms approach the *T. gramen* type in their relative compression, having produced a subacute edge on at least one margin; in *T. gramen*, d'Orb., the chambers are oblique, and both edges are sharp.

Analogies may be found for this varietal form among *T. trochus*, *T. turris*, and *T. Barrettii;* but in detail these *Textilariæ* differ considerably.

Occurrence.—*Textilaria agglutinans*, var. *densa*. The specimen figured, Pl. VI, fig. 17, was found at Broom Hill, zone **d**.

5. Textilaria trochus, *d'Orbigny,* 1840. Plate III, figs. 17, 18.

Part I, 1866, Appendix II, Table, No. 62.

Textularia trochus, *d'Orbigny*, 1840. Mém. Soc. Géol. Fr., vol. iv, p. 45, pl. iv, figs. 25, 26.

— — *Reuss*, 1845. Geinitz's Grundriss, &c., p. 681, pl. xxiv, fig. 76.

— cuneiformis, var. conica, *Williamson*, 1858. Rec. For. Gt. Br., p. 75, pl. vi, figs. 160, 161.

— trochus, *Eley*, 1859. Geol. Garden, p. 199, pl. vi, fig. 34.

— — *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi p. 302 (table).

— — *Iidem*, 1862. In Carpenter's Introd., App., p. 311.

— — *Jones*, 1863. Geologist, vol. vi, p. 294, pl. xv, fig. 3.

— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473.

— cuneiformis, var. conica, *Alcock*, 1864. Proc. Lit. Phil. Manchester, vol. iv, p. 206.

— trochus, *Brady*, 1865. Nat. Hist. Trans. North. and Durham, vol. i, p. 112.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Appendix II, Table, No. 62.

TEXTULARIA TROCHUS, *Vanden Broeck*, 1876. Ann. Soc. Belg. Microsc., vol. ii, p. 132, pl. iii, figs. 11, 12.
— — *Goës*, 1882. K. Svensk. Akad. Handl., vol. xix, p. 80. (Pl. v, figs. 153—158, referred by Dr. Goës to *T. sagittula*, appear to belong to *T. trochus*.)
— — *Brady*, 1884. Report 'Challenger,' p. 366, pl. xliii, figs. 15—19; pl. xliv, figs. 1—3. (Limbate or lipped.)
— — *Agassiz*, 1888. Cruises 'Blake,' vol. ii, p. 165, fig. 501.
— — *Terrigi*, 1889. Atti Lincei Mem., ser. 4, vol. vi, p. 18, pl. v, fig. 4. (Chambers flatter; shell neatly conical.)
— — *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Micr. Soc., p. 553, pl. viii, fig. 14.
— — *Haeusler*, 1890. Abhandl. Schweiz. Pal. Ges., p. 72, pl. xi, figs. 43, 44. (Very broad and flat.)
— — *Chapman*, 1892. Journ. Micr. Soc., p. 328, pl. vi, fig. 18.
— — *Egger*, 1893. Abhandl. k. Ak. Bayer., vol. xxviii, part 2, p. 273, pl. vi, figs. 37, 38. (With lipped or limbate chambers.)
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, pp. 50, 180, 181, 340.

Characters.—Shell short, conical, trochoid, sides rounded; anterior surface circular, and flat or concave. Sutures but little, if at all, excavated. Chambers horizontal, narrow. Texture variable, often rough. This is one of the most symmetrical of the *Textilariæ*.

The only feature by which this species may be distinguished from short specimens of *T. sagittula* is its circular contour; and though the amount of compression in the latter species is, as might be supposed, a very variable character, *T. trochus* still represents a tolerably well-defined group. D'Orbigny's figure is a somewhat idealised representation of the shell, and indicates a much neater and more compact build than is usually seen in nature.

Plecanium Speyeri, Reuss, 1864, 'Sitzungsb. Ak. Wien,' vol. l, p. 449, pl. i, fig. 3, conical, slightly compressed, with horizontal chambers, is near *T. trochus*.

Occurrence. — *Textilaria trochus* has a wide geographical range, and is particularly abundant amidst coral sands of tropical and subtropical latitudes. It is a common Cretaceous fossil,—the species was originally described by d'Orbigny from the White Chalk of the Paris Basin. Its range has lately been shown to extend from the Neocomian (Bargate Beds) of Surrey (Chapman). Other localities from which it has been obtained are the Gault of Folkestone, the Red Chalk of Speeton, the Chalk-marl of Charing (where the species is particularly well developed), the Upper Chalk of Taplow, the Pliocene of Garrucha, and the Pleistocene of Sicily. We have specimens from the Miocene of Muddy Creek,

Victoria. In the Crag the species is not common. It has been found at Sutton; Broom Hill, zones **d** and **e**; Aldborough, zone **g**; Tattingstone, zone **d**; and at Sudbourne Hall, zone **d**, where the species is more common and better developed.

6. Textilaria conica, *d'Orbigny*, 1839. Plate VII, fig. 24.

Textularia conica, *d'Orb.*, 1839. Foram. Cuba, p. 135, pl. i, figs. 19, 20.
— — *Brady*, 1884. Report 'Challenger,' p. 365, pl. xliii, figs. 13, 14; pl. cxiii, figs. 1 *a*, *b*.
— — *Haeusler*, 1890. Abhandl. Schweiz. Pal. Ges., p. 72, pl. xi, figs. 40—42, 45.
— — *Chapman*, 1892. Journ. Royal Microsc. Soc., p. 329, pl. vi, fig. 20. (Somewhat irregular with the last two chambers.)
— — *Egger*, 1893. Abhandl. k. Akad. Bayer., vol. xxviii, part 2, p. 273, pl. vi, fig. 35.

Characters.—Shell short, tapering rapidly to the apex, triangular in outline, more or less compressed, and varying from round to oval in transverse section; chambers horizontal, depressed, narrow in side view.

This may be regarded as a feeble form of *T. trochus*, rather irregular in its growth, and oval in section.

Occurrence.—*Textilaria conica* is a tropical form, commonest perhaps on the coral reefs of the Eastern Archipelago and the West Indies. Specimens were obtained by the "Challenger" from depths varying from 18 to 420 fathoms. There are few records of the occurrence of the species in a fossil condition. It has been noted from the Upper Chalk of Taplow (Chapman). The Crag specimens were obtained with varying frequency from nearly every zone examined. It is most common at Sudbourne Hall, zone **d**.

7. Textilaria gibbosa, *d'Orbigny*, 1826. Plate III, figs. 10—13; and Plate V, figs. 13 and 14.

Part I, 1866, Appendix II, Table, No. 63.

Polymorpha pineiformia, *Soldani*, 1791. Testaceographia, vol. i, part. 2, p. 118, pl. cxxvii, fig. H.
— janiformia, *Idem.* Ibid., p. 119, pl. cxxxii, figs. I, K, L, M; and vol. ii, p. 39, pl. xiv, fig. *h*.
Nautili amphorarii vel janiformes, *Idem*, 1798. Ibid., App., p. 141, pl. 7, figs. 46 *e*, E. [1]

[1] These rough and often obscure figures appear to have reference to *Textilariæ* more or less closely allied to *T. gibbosa*, d'Orb.

TEXTULARIA GIBBOSA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 262, No. 6; Modèle, No. 28.
— OBTUSA, *Idem.* Ibid., p. 262, No. 1.
— LÆVIGATA, *Idem.* Ibid., p. 262, No. 2.
— PUNCTULATA, *Idem.* Ibid., p. 262, No. 4.
— PARTSCHII, *Czjzek*, 1848. Haidingers Nat. Abhandl., vol. ii, p. 148, pl. xiii, figs. 22—24.
TEXTILARIA PUPA, *Reuss*, 1860. Sitzungsb. k. Akad. Wiss. Wien, vol. xl, p. 232, pl. xiii, fig. 5 only (not fig. 4). (= short, gibbose.)
TEXTULARIA GIBBOSA, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302 (Table).
TEXTILARIA MINIMA, *Karrer*, 1865. Novara-Exp. Geol. Th. Pal., p. 79, pl. xvi, fig. 9. (Short form.)
PLECANIUM KARRERI, *Stache*, 1864. Ibid., p. 178, pl. xxi, fig. 17.
— GRANOSISSIMUM, *idem.* Ibid., p. 179, pl. xxi, fig. 18.
— EURYSTOMA, *idem.* Ibid., fig. 19.
TEXTULARIA GIBBOSA, *P., J., and B.*, 1865. Ann. Mag. N. H., ser. 3, vol. xvi, p. 23, pl. ii, fig. 60.
— — *Iidem*, 1866. Monogr. Foram. Crag, Appendix II, Table, No. 63.
TEXTILARIA OVALIS, *Kübler and Zwingli*, 1866. Neujahrsblatt, &c., p. 19, pl. iii, Untere Kreide, fig. 6.
— ZWINGLII, *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 30, pl. iii, fig. 44.
TEXTULARIA GIBBOSA, *Brady*, 1876. Monogr. Carb. Perm. Foram., Pal. Soc., p. 131, pl. x, figs. 26 *a*, *b*. (With a list of synonyms.)
PLECANIUM GIBBUM, *Zittel*, 1876. Palæont., vol. i, p. 89, fig. 26.
TEXTULARIA GIBBOSA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 116, 275, 276.
— — *Idem*, 1887. Ibid., vol. vi, fasc. 2, p. 160 (with synonyms), pl. ii, figs. 1 *a*, *b*.
— — *Idem*, 1887. Ibid., vol. vi, p. 160, pl. ii, figs. 1, 1 *a*, 1 *b*.
— AGGLUTINANS? *Malagoli*, 1887. Ibid., vol. vi, p. 520, pl. xiii, fig. 2.
— GIBBOSA, *Haeusler*, 1890. Abhandl. Schweiz. Pal. Ges., vol. xvii, p. 71, pl. xi, figs. 28—36.
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, pp. 46, 180, 181, 236.
— — var. TRANSCENDENS, *Idem.* Ibid., p. 237, pl. iii, fig. 5.
— PARTSCHII, *Egger*, 1893. Abhandl. k. Ak. Bayer., vol. xxviii, part 2, p. 267, pl. vi, figs. 22, 23 (triangular and tapering each way).

Characters.—Shell subtriangular, tapering, constricted at the sutures, depressed along the line of the juxtaposition of the two series of chambers. Margin rounded. Chambers ventricose. Texture coarse.

The bold, coarse-shelled *Textilariæ* with gibbose or subglobular chambers, and of somewhat irregular growth, commoner as Tertiary fossils than in the recent condition, form a natural group between the more delicate and regular *T. globulosa*, Ehrenberg, and the thick and coarse forms of *T. agglutinans*.

It is not uncommon to meet with specimens in which the chambers are subdivided into chamberlets, as shown in two of our figures (Pl. III, fig. 12, and Pl. V, fig. 13). Another but much less frequent variation from the normal habit is represented in the double shell found in one of the Sutton gatherings, Pl. III, fig. 13.

T. gibbosa has many analogues in the sharp-edged forms known as *T. subangulata*, *gramen*, and *abbreviata*, d'Orb., and their numerous allies. These become *gibbosa* by being less compressed, their chambers sloping less, and their lateral edges more rounded.

Bigenerina patula, Brady, 1876, 'Monogr. Carb. Perm. Foram.,' p. 136, pl. viii, figs. 10, 11, and pl. x, figs. 30, 31 (afterwards *Climacammina*, *in literis*), is a bigenerine *gibbosa*, with its chambers subdivided into labyrinths.

About fourteen fossil specimens of *Textilaria gibbosa*, d'Orb., are figured in Ehrenberg's memoirs under various names; see 'Ann. Mag. Nat. Hist.,' ser. 4, vols. ix and x, 1872, especially p. 456; and occasionally Ehrenberg illustrated recent specimens, op. cit., pp. 222 and 254.

Occurrence.—*Textilaria gibbosa.* No recent specimen of this form is recorded in the 'Challenger' Report, but it is noted ('Quart. Journ. Geol. Soc.,' vol. xvi, 1860, Table, p. 302) as occurring at Venice (on the Lido) and at Rimini (Adriatic). Fossil specimens have been found in the Gault of Folkestone, in the White Chalk, the Miocene of Vienna, of Malaga, and of Muddy Creek (Victoria); the older Tertiaries of South Australia (Howchin), and the Helvetian of Italy (de Amicis). In the Coralline Crag *T. gibbosa* is one of the commonest and best developed of the *Textilariinæ.* The specimens obtained from Sutton, zone **f**, and Sudbourne Hall, zone **d**, are particularly fine.

8. Textilaria tuberosa, *d'Orbigny*, 1826. Pl. V, fig. 17.

Polymorphum janiforme,[1] *Soldani*, 1798. Testaceogr., &c., vol. ii, pp. 39 and 45, pl. xiv, fig. *h*.

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[1] Among the many misprints in d'Orbigny's "Tableau méthodique," &c., in the 'Ann. Sci. Nat.,' vol. vii, the reference at p. 263 to "Sold. 4, p. 39, Tab. 14, fig. *H*, *Polymorphium* [sic] *tuberosum*," is one of the most misleading. The "Polymorpha tuberosa" of vol. i, part 3, p. 39, are described by Soldani as figured under "*f*, *g*," in pl. xiv, from the vase cxxvi: fig. *h*, of pl. xiv, from the vase cxxvii, and referred to by Soldani, at pp. 39 and 45, as one of the "janiformia," is evidently the one quoted by d'Orbigny as "fig. *H*," and named by him *Text. tuberosa* under a mistake, and without carefully reading the text.

TEXTULARIA TUBEROSA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 263, No. 26.
— CLYPEATA, *Costa*, 1856. Atti Accad. Ponton., vol. vii, p. 295, pl. xxiii, fig. 4.
PLECANIUM TUBERIFORME, *Seguenza*, 1880. Atti Accad. Lincei, ser. 3, vol. vi, p. 152, pl. xiv, fig. 9.
TEXTULARIA PUNCTULATA, *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. iii, p. 182.
— TUBEROSA, *Idem*, 1887. Ibid., vol. vi, p. 161, pl. ii, figs. 2, 2 *a*, 2 *b*.
— — *de Amicis*, 1893. Ibid., vol. xii, fasc. 3, pp. 45, 180, 181.

Subovate; chambers neat and small at first, swollen afterwards; not so compact as in *gibbosa*, nor enlarging so rapidly with their growth, and therefore forming a less broadly triangular shell. At p. 169, 'Ann. Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, pl. xi, fig. 119, *Textilaria tuberosa* is referred to as "belonging probably to *T. gibbosa*." So also *T. obtusa*, *lævigata*, and *punctulata*, d'Orb., are combined with *T. gibbosa* (ibid., p. 167, pl. xi, figs. 115—117).

Occurrence.—This species, founded by d'Orbigny on a figure given by Soldani, is not recorded in the 'Challenger' Report as occurring in the recent condition. Fossil specimens have been recorded from the Pliocene of Tuscany and the Miocene of Sardinia (de Amicis). The Crag specimen figured on Pl. V, fig. 17, is in the Searles-Wood Collection, British Museum, and was obtained from Sutton.

9. TEXTILARIA GLOBULOSA, *Ehrenberg*, 1838. Plate VI, figs. 18 *a*, *b*, *c*.

TEXTILARIA GLOBULOSA, *Ehrenb.*,[1] 1838. Abhandl. Preuss. Akad. Wiss., 1838, p. 135, pl. iv, fig. β.
TEXTULARIA GLOBULOSA, *Bailey*, 1843. In Hitchcock's Reports I, II, III, Assoc. Americ. Geol. and Nat., 1843, p. 357, pl. xv, figs. 1, 3, 4, 5, 7.
— — *Reuss*, 1845. Böhm. Kreidef. I, p. 39, pl. xii, fig. 23.
— — *Idem*, 1846. In Geinitz's Grundriss, &c., p. 681, pl. xxiv, fig. 74.

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[1] This species is represented under various appellations in Ehrenberg's 'Mikrogeologie,' 1854,—pl. xxiii, figs. 3—6; pl. xxiv, figs. 12—14; pl. xxv, I A, figs. 9—11; pl. xxv, III C; pl. xxvii, fig. 6; pl. xxviii, figs. 9, 10; pl. xxix, fig. 17; pl. xxx, fig. 3 *a*; pl. xxxi, figs. 12, 13; pl. xxxii, II, figs. 12, 13; pl. xxxvii, VI, figs. 6, 7; 'Abhandl. Preuss. Akad. Wiss.,' 1856, p. 161, pl. ii, fig. 1. These are referred to in detail in the 'Ann. Mag. Nat. Hist.,' ser. 4, vol. ix, 1872, pp. 280, 284, 287, 289, 292, 298; vol. x, 1872, pp. 185, 188, 193, 197. In vol. ix, at pp. 222, 223, 255, 257, and 264, some miscellaneous occurrences are also noticed of this little organism, recent and fossil, as figured by Ehrenberg. A full synonymy of this species will be published in the second part of C. D. Sherborn's 'Index of the Genera and Species of Foraminifera,' which the Smithsonian Institution will issue this year.

TEXTILLARIA GLOBULOSA, *Williamson*, 1847. Mem. Lit. Phil. Soc., Manchester ser. 2, vol. viii, p. 76, pl. [4], fig. 61 (var. slightly irregular).
— GIBBOSA, *Idem*, 1872. Ibid., ser. 3, vol. v, p. 136.
TEXTULARIA GLOBULOSA, *Harting*, 1849. Magt. Kleine, p. 119, figs. 5 and 8; 1851 (German ed.), p. 87, fig. 39.
— — *Mantell*, 1854. Medals of Creation, 2nd edit., vol. i, p. 342, fig. 1092.
TEXTILARIA GLOBIFERA, *Reuss*, 1860. Sitzungsb. k. Akad. Wien, vol. xl, p. 232, pl. xiii, fig. 8 (not fig. 7).
— GLOBULOSA, *Bronn*, 1853–6. Lethæa, &c., 3rd edit., vol. iii, p. 235, pl. xxxv, figs. 32 *a, b*.
TEXTULARIA STRIATO-PUNCTATA, *Egger*, 1857. N. Jahrb., &c., p. 294, pl. iii, figs. 27, 28 (ornamented).
— GLOBULOSA, *Eley*, 1859. Geology in the Garden, pp. 194 and 201, pl. ii, fig. 9; pl. vii, figs. 39, 39 *c*; pl. ix, fig. 9 *c*.
[— —] *Hitchcock*, 1860. Elem. Geol., 30th edit., p. 382, figs. 203 (two), 204 (one), 205 (one), 207 (one); p. 383, fig. 308 (one).
— — *Heer*, 1865. Urwelt Schweiz, vol. i, p. 197, fig. 109; 1876, Engl. edit., p. 207, figs. 109 *a—d*.
— — *Hartwig*, 1866. The Sea, &c., 3rd edit., p. 381, fig. *f*.
TEXTILARIA GIGAS, T. INÆQUILATERALIS, et T. GLOBIGERINA, *Kübler and Zwingli*, 1866. Neujahrsblatt, &c., p. 18, pl. iii, figs. 9, 12, and 13.
TEXTULARIA GLOBULOSA, *Brady*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 300, pl. xii, figs. 4 *a, b*.
BOLIVINA, Nos. 507 and 508, *Schlicht*, 1870. Foram. Sept. Pietzpuhl, p. 87, pl. xxxiii, figs. 27 and 28, and figs. 29 and 30 (irregular in growth). Referred to *T. globifera* by Reuss.
TEXTULARIA GLOBULOSA, *Greene*, 1871. Manual Protozoa, p. 15, fig. 3*f*.
— — *G. M. Dawson*, 1874. Canad. Nat., ser. 2, vol. vii, p. 253, fig. 1 *a* (striate).
— GIBBOSA, var. GLOBULOSA, *Idem*, 1875. Report Geol. Forty-ninth Parallel, p. 79, pl. xvii, fig. *a* (striate).
— GLOBIFERA, *Zittel*, 1876. Handb. Paläont., I, p. 90, fig. 27 (striate).
— GLOBULOSA, *Morris*, 1876. Lecture Croydon, p. 8, fig. 3 *a*.
— — *J. W. Dawson*, 1876. Proceed. Am. Assoc. for 1875, p. 103, fig. 4 *a* (striate).
TEXTILARIA GLOBULOSA, *Schwager*, 1877. Boll. Com. Geol. Ital., vol. viii, p. 26, pl. 0, fig. 60 (striate).
TEXTULARIA GLOBULOSA, *Anon.*, 1883. Amer. Cyclop., vol. vii, p. 311, fig. 1.
TEXTILARIA GRACILLIMA, *Andreae*, 1884. Abhandl. Geol. Special-Karte Elsass-Lothringen, vol. ii, Heft 3, p. 235, pl. viii, fig. 9 (long var.).

Textularia globulosa, *Woodward and Thomas*, 1885. 13th Report Minnesota, p. 166, pl. iii, figs. 1—6.
— gibbosa, *Malagoli*, 1887. Atti Soc. Nat. Modena (Rend.), ser. 3, vol. iii, p. 108, pl. i, fig. 2.

Characters.—Test consisting of globose chambers, arranged as an inverted cone, varying among individuals in the relative width of the parallel alternate series. Many small specimens widen out quickly, and have but few chambers above the first; others grow on with many chambers, more closely set, in a slowly tapering cone (such as *T. gracillima*, Andreae; and the still more attenuate *T. elongata*, Cornuel); others of medium size and proportions, losing the roundness and distinctness of the segments, pass into *T. gibbosa*, d'Orb.

Occurrence.—Textilaria globulosa.—This species, described by Ehrenberg, has a wide geographical range, chiefly in the Cretaceous series. The localities whence the specimens figured by Ehrenberg were obtained are—Cretaceous, Egypt, Syria, Arabia (?), France, England, Islands of Möen and Rügen in the Baltic, Bohemia, Russia, and Missouri; Eocene, Egypt and Bavaria; also from volcanic mud in the Eastern Archipelago, and from wind-dust at Malta, Lyons, and Silesia or Austria. Dr. H. B. Brady has recorded it as occurring in a brackish tidal pond at Westport, Ireland. It is a common Cretaceous fossil, being recorded from the Chalk of Swanscombe (zone of *Micraster cor-testudinarium*), from the Chalk of Taplow (zone of *Belemnitella quadrata*), from the Chalk of Westphalia, by Reuss, under the name *T. globifera*, by Andreae, from the Oligocene of Elsass, under the name *T. gracillima*; and recently by Millett from the Pliocene of St. Erth. Only one specimen has been met with in the Crag, and that in the Chillesford Beds of Aldeby, near Beccles.

Genus 2.—Bigenerina, *d'Orbigny*, 1826.

Brady, Report 'Challenger,' 1884, pp. 68 *and* 368.

Synonyms :

Nautilus, pars, *Batsch.*
Orthoceras, pars, *Soldani.*
Bigenerina, *d'Orb., Römer, Reuss, Costa, Parker and Jones, Karrer, Brady, Schwager, M. Sars, Vanden Broeck, Winther, Terrigi, Ba sset, Malagoli, Goës, Fornasini*, and others.
Gemmulina, *d'Orbigny.*
Vulvulina, pars, *d'Orb., Reuss.*
Clavulina, pars, *d'Orb., Karrer.*
Grammostomum, *Reuss, P. and J., Brady.*
Polymorphina, pars, *Ehrenberg.*
Textularia, *Goës.*

SCHIZOPHORA, *Reuss, Hantken, Karrer, Seguenza, Schlumberger.*
VENILINA, *Gümbel.*
CLIMACAMMINA, *Brady, Schwager.*
STYLOLINA ? *Karrer.*
CRIBOSTOMUM, pars, *Möller.*

General Characters.—Textilarian; dimorphous, being biserial in early growth' and uniserial in a straight line afterwards; aperture terminal, round, and sometimes pouting.

1. BIGENERINA NODOSARIA, *d'Orbigny*, 1826. Plate III, fig. 19 (*Verneuilina communis*).

Part I, 1866 (*Verneuilina communis*), Appendix II, Table, No. 65.

BIGENERINA NODOSARIA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 261, No. 1, pl. xi, figs. 9—12; Modèle No. 57.
— PUSILLA, *Römer*, 1838. N. Jahrb. für Min., &c., p. 384, pl. iii, fig. 20.
— AGGLUTINANS, *d'Orb.*, 1846. For. Foss. Vienne, p. 238, pl. xiv, figs. 8—10.
— NODOSARIA, *Reuss*, 1846. In Geinitz's Grundr. Verstein., p. 677, pl. xxiv, fig. 67.
— TORULOSA, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 285, pl. xv, fig. 12.
— ANNULATA, *Idem.* Ibid., p. 284, pl. xv, fig. 13.
— BIFIDA, *Idem.* Ibid., p. 287, pl. xxiii, fig. 1.
— NODOSARIA, *P. and J.*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xi, p. 97.
CLAVULINA ELEGANS, *Karrer*, 1864. Novara-Exped. Geol. Theil, vol. i, p. 80, pl. xvi, fig. 11.
BIGENERINA NODOSARIA, *Reuss*, 1865. Model No. 58. (Catal. No. 12, 1861.)
— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 28, pl. ii, fig. 62.
TEXTULARIA AGGLUTINANS, var. (BIGENERINA) NODOSARIA, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 371, pl. xv, fig. 25; and pl. xvii, fig. 80.
VERNEUILINA COMMUNIS, *J., P., and B.*, 1866. Monogr. Foram. Crag, No. 65, Table, Appendix II.
BIGENERINA NODOSARIA, *Terrigi*, 1880. Atti Accad. Pont., ann. xxxiii, p. 192, pl. ii, fig. 28.
TEXTULARIA GIBBOSA, forma BIGENERINA, *Goës*, 1882. K. Svensk. Vet. Akad. Handl., vol. xix, No. 4, p. 79, pl. v, figs. 162—164.
BIGENERINA AGGLUTINANS, var. NODOSARIA, *Jones*, 1883. In Microgr. Dict., ed. 4, p. 96, pl. xiii, figs. 50 *a*, *b*.
— NODOSARIA, *Brady*, 1884. Report 'Challenger,' p. 369, pl. xliv, figs. 14—18.

BIGENERINA NODOSARIA, *Basset*, 1885. Acad. Rochelle; Soc. Sci. Nat. Charente. Inf.-Annales de 1884, No. 21, p. 161, and fig. 57 (d'Orbigny's model).
— — *Malagoli*, 1887. Atti Soc. Nat. Modena (Rend., ser. 3, vol. iii, p. 108, pl. i, figs. 3 and 4.
— — *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 52, 180, 181.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 37, pl. vii, figs. 313—323.
— — *Fornasini*, 1894. Coll. Soldani, Sagg. Oritt., p. 16.

Characters.—Initial part of the shell more or less triangular in outline, varying in relative size, and nearly always distinct from the succeeding moniliform series. Test variable in regularity of form, and in the roughness of surface.

Occurrence.—Most common in shallow waters of the North Atlantic. Fossil in the Middle and Upper Tertiaries. Rare at Sutton.

Genus 3.—SPIROPLECTA, *Ehrenberg*, 1845.

Berichte Berliner Akad. Wiss. for 1844, *p.* 75. *Brady, Report 'Challenger,'* 1884, *pp.* 68 *and* 375.

TEXTILARIA, *Ehrenberg*.
HETEROHELIX, *Ehrenberg*.
SPIROPLECTA, *Ehrenberg, Parker and Jones, Brady, Balkwill and Wright, Bronn, Chapman, Millett, Woodward and Thomas, Halkyard*.
TEXTULARIA (pars), *Parker and Jones, Brady, Norman*.

General Characters.—A dimorphous Textilarian form; early segments planospiral, the following biserially alternate; the last not unfrequently uniserial. Test either hyaline or sandy.

1. SPIROPLECTA ROSULA, *Ehrenberg*, 1854. Plate VII, fig. 25.

SPIROPLECTA ROSULA, *Ehrenberg*, 1854. Mikrogeologie, Inhalt des Atlas, p. 24, pl. xxxii, II, fig. 26.
TEXTULARIA COMPLEXA, *Brady*, 1865. Nat. Hist. Trans. Northumb. Durham, vol. i, p. 101, pl. xii, figs. 6 *a*, *b*; and Rep. 'Chall.,' 1884, p. 377, foot-note.
SPIROPLECTA DEMERSA, *Ehrb.*, 1873. Abhandl. Berliner Akad. Wiss. for 1872, p. 247, pl. vii, fig. 26.
— NANA, *Ehrb.*, 1873. Ibid., p. 247, pl. v, fig. 17.
— ROSULA, *Egger*, 1893. Abhandl. k. Bayer. Ak.-Wiss., vol. xviii, Abth. II, p. 274, pl. vii, figs. 13, 14.

Characters.—A small hyaline Textilarian shell, beginning with a flat spire, and growing on with regular biserial chambers, making a narrow and somewhat compressed test, of uniform width, and with rounded edges.

The name *Spiroplecta rosula* was given by Ehrenberg to a (hyaline ?) shell resembling in general contour the arenaceous form subsequently described by Parker and Jones ('Phil. Trans.,' 1865, vol. clv, p. 370, pl. xv, figs. 23, 24) under the name *Textularia agglutinans*, var. *biformis.*

On the same plate with *Spiroplecta rosula* in the 'Mikrogeologie,' Ehrenberg figured an allied form, but widening out in its growth (after the manner of *Text. gibbosa*) as *Sp. Americana.* This was at first regarded by him as a *Textilaria*, but its name was changed to *Heterohelix* in the 'Abhandl. Berliner Akad. Wiss.' for 1841 (1843), p. 429, No. 302; see also the 'Mikrogeol. Inhalt des Atlas,' 1854, p. 22. At page 24 of the same index it is referred to as *Spiroplecta Americana* from the Chalk of Missouri and Mississippi. It is doubtful if the test of this form and of *Sp. rosula* (also from the Chalk of Mississippi) is represented as hyaline or opaque in this plate; and Ehrenberg nowhere defines their shell-structure. Dr. H. B. Brady found that in recent specimens of *Sp. Americana* "the walls are thin and smooth, and in small specimens hyaline" (op. cit., p. 376). Clear-shelled forms like *Sp. rosula* have been found in existing seas. Of these recent "species," some mentioned above are *Sp. demersa*, Ehr., from the Philippines; and *Sp. nana*, Ehr., from Florida; of the latter there are (1) one of irregular growth, and (2) a young individual.

Other closely related hyaline forms are—

Spiroplecta abyssorum, Ehrenb., 1873. 'Monatsber. k. Preuss. Akad. Wiss.' for 1872, p. 293; 'Abhandl. Berl. Akad. Wiss.' for 1872, pp. 144 and 247 (Atlantic Telegraph-Line).

Sp. Capensis, Ehrenb., 1873. Ibid., p. 294; and ibid., p. 247 (Lagullas Bank).

Sp. ? profundissima, 1873. Ibid., p. 294 (Coral Sea). Imperfect individual.

Ehrenberg also noted and figured in 1856, 'Abhandl. Berl. Ak. Wiss.' (Physikal) for 1855, p. 169, pl. iv, fig. 13, a glauconitic cast of "*Spiroplecta* ——— ?" from the Zeuglodon Limestone of Alabama.

Occurrence.—Recent specimens of *Spiroplecta* are of rare occurrence, and are usually confined to the shallow waters of northern seas. These are, moreover, usually arenaceous; but the hyaline form, *S. rosula*, has been found on the north-east coast of England (Brady) and in the Philippine seas (Ehrenberg). In the fossil condition *S. rosula* has been recorded from the Cretaceous series of North America (Ehrenberg), and from the Pliocene beds of St. Erth (Millett). One specimen only has been found in the Coralline Crag, and that from Gedgrave, zone **f**.

Sub-family 2.—BULIMININÆ.

Brady, Report 'Challenger,' 1884, *pp.* 68, 355, *and* 397.

General Characters.—Typically spiral; sometimes biserial; aperture oblique, usually curved, and more or less comma-shaped.

Genus 1.—BULIMINA,[1] *d'Orbigny*, 1826.

See also Brady, Report 'Challenger,' 1884.

BULIMINA, *d'Orbigny, Sander-Rang, Menke, Bronn, Römer, Reuss, Alth, Bailey, Schultze, Costa, Bornemann, Parker and Jones, Egger, Williamson, Karrer, Carpenter, Brady, M. Sars, Schwager, Gümbel, Hantken, Dawson, Prestwich, Terquem, Zittel, Terrigi, Goës, Stache, Alcock, Parfitt, Marsson, Seguenza, Wright, Eley, Pictet, Andreae, Sherborn, Chapman, Dana, Chimmo, Fornasini, Millett, and others.*

TEXTULARIA, pars, *d'Orb.*

ROBERTINA, *d'Orbigny, Reuss.*

ROTALINA, pars, *Reuss.*

CUCURBITINA, pars, *Costa.*

ATAXOPHRAGMIUM, *Reuss, Karrer.*

PULVINULINA, pars, *Jones and Parker.*

CASSIDULINA, pars, *Brady.*

POLYMORPHINA, pars, *Ehrenberg.*

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[1] At page 398 of the 'Report on the Foraminifera' collected during the voyage of the 'Challenger,' &c., 1884, the genus *Bulimina* is stated to have had a geological range from the "Upper Trias (Parker and Jones)" to the Tertiary and present times. This and similar statements about other genera and species in the Report, and in memoirs and papers by other workers, including the First Part of the Monograph of the Foraminifera of the Crag (page 48), is due to a mistake as to the real locality of some "Blue Clay," supposed to have come from the alabaster pits at Chellaston, Derbyshire. See the paper by T. R. Jones and W. K. Parker, "On some Fossil Foraminifera from Chellaston, near Derby," 'Quart. Journ. Geol. Soc.,' vol. xvi, 1860, pages 452—458, pls. xix and xx.

The "Triassic" age of these Foraminifera has always been doubted, and personal inquiries and search were made without definite results; but their unmistakable *Liassic* facies, and the doubts existing about the exactness of the workmen's statements, have led us to believe that this "blue clay" came from some Lias in Leicestershire, having probably been inadvertently thrown in with the "red clay" on its journey to Cubitt's works in London.

In the 'Journal of the Northamptonshire Natural-History Society,' vol. vii, 1892, page 68, Messrs. W. D. Crick and C. D. Sherborn referred to the probable Liassic character of the above-mentioned blue clay. In the 'Annuaire géologique universel,' vol. ix, 1894, p. 922, the editor observes, "This study permits of our fixing precisely the level of the 'blue clay of Chellaston,' which has been attributed to the Trias, the fossils being undoubtedly those of the Upper Lias."

General Characters.—Typically spiral, short or elongate; trochoid or sub-cylindrical; last convolution proportionally large; segments numerous, small at first, septal plane of each segment generally directed inwards towards the central umbilical axis, and rapidly increasing in size; aperture a simple loop-like slit, oblong; or arcuate in the septal face, and directed obliquely or vertically downwards, but sometimes nearly round; one of its lips passing behind the other at its umbilical margin. The chambers in the whorls may be many or few, inflated or compact; the convolution may be either produced or depressed, thus forming either a long or a short shell. The *Buliminæ* with arenaceous tests have been grouped under the name *Ataxophragmium* by von Reuss, 'Sitzungsb. Akad. Wiss. Wien,' vol. xliv, 1861, p. 383. See also Carpenter's 'Introd. Study Foram.,' Ray Soc., 1862, pp. 194—197.

1. Bulimina elegans, *d'Orbigny*, 1826. Woodcut, fig. 17.

Part I, 1866, Appendix II, Table, No. 66.

Bulimina elegans, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 270, No. 10, Modèle No. 9.
[— —] *Costa*, 1838 (?). Fauna R. Nap., Foram., pl. iii, fig. 6 *a*, A, B, C (not described).
— — *J. and P.*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, Table, No. 55.
— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 20, pl. ii, fig. 64.
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Appendix II, Table, No. 66. (The specimen from Chillesford here alluded to has been lost sight of.)
— — *Brady*, 1884. Report 'Challenger,' p. 398, pl. l, figs. 1—4.
— — *Gümbel*, 1885. Geol. Bayern., vol. i, pt. 2, pp. 421, 422, fig. 266, 19.
— — *Chapman*, 1892. Quart. Journ. Geol. Soc., vol. xlviii, pp. 514, 516, 518, pl. xv, fig. 9.
— — *Egger*, 1893. Abhandl. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 284 and 446, pl. viii, figs. 66 and 67.

Fig. 17.—*Bulimina elegans*, d'Orb. × 60. Specimen from the Coralline Crag at Broom Hill, zone d.

Characters.—Test triserial, tapering, with numerous rather inflated chambers; acute below, obtuse above.

Occurrence.—*Bulimina elegans* is stated by Brady in the 'Challenger' Report to occur not uncommonly in the North and South Temperate Zones, at depths ranging from 11 to 1630 fathoms. In the tables at the end of the 'Challenger' Report no mention is made of the species. D'Orbigny's specimens were obtained from the Adriatic, near Rimini. The geological range of *B. elegans* extends back to the Chalk of Swanscombe and Taplow (Chapman). We have noticed no occurrence of the species in Tertiary formations older than the Pliocene, in which it has been recorded from the Italian beds. We have it in our own Collection from the Scaldisian of Antwerp.

In the Coralline Crag we have specimens from Sudbourne Hall and Broom Hill, zone **d**; Gedgrave, zone **f**; and Aldborough, zone **g**. In the Upper Crag the only record is from Chillesford, as indicated in the First Part of the Monograph.

1*. Bulimina elegans, *d'Orbigny*, 1826. Var. Plate VI, fig. 19.

Bulimina elegans [var.], *Brady*, 1884. Report 'Challenger,' p. 398, pl. 1, figs. 3, 4.

Characters.—The specimen shown by Pl. VI, fig. 19, is not so symmetrically tapering a form as is usual with *B. elegans*. In this respect it does not resemble Brady's figs. 1 and 2, but the more cylindric and clumsier figs. 3 and 4, which it will be convenient to regard as a varietal form.

Some closely related (zoologically identical) forms have been described and figured by G. Stache ('Novara-Exped., Geol. Theil.,' vol. i, part 2, Palæontology, 1866, pp. 265–7, pl. xxiv, figs. 13—16), varying chiefly in respect to size, and named *Bulimina pupula*, sp. n., *ovata*, d'Orb., var., *aperta*, sp. n., and *propinqua*, sp. n. Of these *B. pupula* (fig. 13) is a *short* representative of our fig. 19, which latter is intermediate to *B. aperta* and *propinqua*.

Occurrence.—The figured specimen is from the Coralline Crag at Sudbourne Hall, zone **d**.

2. Bulimina aculeata, *d'Orbigny*, 1826. Plate III, figs. 1, 2.

Part I, 1866, Appendix II, Table, No. 67.

Polymorpha *pineiformia*, *Soldani*, 1791. Testaceogr., vol. i, part 2, p. 118, pl. cxxvii, fig. I and K (?); pl. cxxx, fig. vv; and pl. cxxxi, fig. xx (?).

Bulimina aculeata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 269, No. 7.
— trilobata, *Idem.* Ibid., p. 269, No. 6.
— patagonica, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 50, pl. i, figs. 8, 9.
Textularia echinata, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 263, No. 24.
Bulimina aculeata, *Reuss*, 1850. Denk. Ak. Wien, vol. i, p. 374, pl. xlvii, fig. 13.
— pupoides, var. spinulosa, *Williamson*, 1858. Recent Foram. Great Brit., p. 62, pl. v, fig. 128.
— aculeata, *Jones and Parker*, 1860. Q. J. G. S., vol. xvi, p. 303.
— spinosa, *Seguenza*, 1862. Atti Acc. Gisen., ser ii, vol. xviii, p. 107, pl. i, figs. 8, 8 *a*.
— Presli, var. aculeata, *P. and J.*, 1862. Introd. Foram., Appendix p. 311.
— — — 1865. Phil. Trans., vol. clv, p. 373, pl. xvii figs. 68, 69.
— aculeata, *J., P., and B*, 1866. Monogr. Foram. Crag, Appendix II, pl. iii, figs. 1, 2.
— — *Reuss*, 1867. Sitzungsb. Akad. Wiss. Wien, vol. lv, p. 95.
— — *Sars*, 1868. Vidensk-Selsk Forhandl. for 1868, p. 249.
— — *Parker, Jones, and Brady*, 1871. A. M. N. H., ser. iv, vol. viii, p. 172, pl. cxi, figs. 126—128.
— — *Siddall*, 1879. Catal. Brit. Rec. For., p. 8.
— — *Brady*, 1884. Report 'Challenger,' p. 406, pl. li, figs. 7—9.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 220, pl. xliii, fig. 8.
— — *Egger*, 1893. Abh. k. Bay. Ak. Wiss., vol. xviii, pt. ii, p. 287, pl. viii, figs. 72 and 78.

Characters.—This is an ovate (or rather obovate) *Bulimina*, allied to *B. affinis* and *pupoides*, d'Orb., but ornamented with exogenous shell-growth in the form of prickles attached either to the earlier chambers only, or to the edges and sides of the same in the aftergrowth. The ornament varies considerably in amount. In our fig. 1 in Plate III it appears to be scanty, or it may have been worn off. Williamson's *B. spinulosa*, and the bizarre Soldanian figures associated with *B. aculeata* in the 'Ann. Mag. Nat. Hist.,' 1871 (see above), may be taken for extreme examples.

Occurrence.—*Bulimina aculeata* has a very wide geographical range, but affects more especially the deeper waters. It has been found as far north as the north coast of Norway, through the temperate and tropical seas; and as far south as the Antarctic Ice Barrier. Its bathymetrical range extends from 75 to 2740 fathoms.

Its earliest recorded geological occurrence appears to be in the Miocene of Vienna. It has also been found in the Pliocene of Italy, Garrucha (South Spain), and St. Erth. So far as the Crag is concerned, we have nothing to add to the record from the Upper Crag of Southwold given in the First Part of the Monograph.

3. BULIMINA MARGINATA, *d'Orbigny*, 1826. Plate III, figs. 5 and 6.

Part I, 1866, Appendix II, Table, No. 68.

BULIMINA MARGINATA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 269, No. 4, pl. xii, figs. 10—12.
— PULCHELLA, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 50, pl. i, figs. 6, 7 (an elongate form).
— ACANTHIA, *Costa*, 1856. Atti Acc. Pont., vol. vii, p. 335, pl. xiii, figs. 35, 36.
— ELEGANS, *Idem*. Ibid., p. 334.
CUCURBITINA CRUCIATA, *Idem*. Ibid., p. 336, pl. xviii, fig. 7.
BULIMINA MARGINATA, *Parker and Jones*, 1857. A. M. N. H., ser. 2, vol. xix, p. 296, pl. xi, figs. 39 and 40.
— PUPOIDES, var. MARGINATA, *Williamson*, 1858. Rec. For. Gt. Brit., p. 62, pl. v, figs. 126, 127.
— PRESLII, var. MARGINATA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 372, pl. xv, fig. 10; pl. xvii, fig. 70.
— — — *Sars*, 1865. Foss. Dyr. Qvart., pp. 66, 68.
— PUPOIDES, var. MARGINATA, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.
— MARGINATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendix II, pl. iii, figs. 5, 6.
— — *G. M. Dawson*, 1870. Canad. Nat., n. s., vol. v, p. 179.
— — *Terrigi*, 1880. Atti Accad. Pont. Nuovi Lincei, vol. xxiii, p. 194, pl. ii, figs. 35, 36.
— — *Brady*, 1884. Report 'Challenger,' p. 405, pl. li, figs. 3—5.
— — *Brady, Parker, and Jones*, 1888. Tr. Zool. Soc., vol. xii, part 7, p. 220, pl. xliii, figs. 7 & 10.
— — *Egger*, 1893. Abh. k. Bay. Ak. Wiss., vol. xviii, pt. 2, p. 287, pl. viii, figs. 69, 70.
— — *Goës*, 1894. K. Sv. V.-Ak. Handl., vol. xxv, No. 9, p. 46, pl. ix, figs. 439—444.

Characters.—More or less ovate (obovate) and tapering; the chambers extend backwards with a free edge (marginate), which is crenate, serrate, or prickly.

Occurrence.—*Bulimina marginata* has a very wide geographical and bathymetrical range. In the Distribution Tables appended to the 'Challenger' Report it is recorded from the South and North Pacific, 345—675 fathoms; between Prince-Edward Island and Kerguelen, 1375 fathoms; off the coast of New Guinea, 1070 fath.; off the west coast of Patagonia, 40—175 fath., W. Australia ('Gazelle').

The earliest recorded geological occurrence of this species appears to be in the Miocene of Italy. It has also been found in the Pliocene of St. Erth, and in the Pleistocene of Norway, Scotland, and Ireland. So far as the Crag is concerned,

we have nothing to add to the record given in the First Part of the Monograph, namely, from the Crag with *Cyprina* (= *Arctica*) *Islandica*.

Genus 2.—Virgulina, *d'Orbigny*, 1826.

Brady, Report '*Challenger*,' 1884, *pp.* 68 *and* 413.

Virgulina, *d'Orbigny, Römer, Bronn, Reuss, Czjzek, Egger, Parker and Jones, Karrer, Brady, M. Sars, von Hantken, Schultze, Robertson, Geinitz, Terrigi, Andreae, Malagoli, Basset, Seguenza, Pictet, Goës, Schwager.*
Bulimina, *Bailey, Parker and Jones, Williamson.*
Polymorphina, *Costa.*

In Ehrenberg's 'Mikrogeologie' several species of *Virgulina* are referred to under the names of *Grammobotrys*, *Grammostomum*, *Heterostomum*, *Pleurites*, *Sphæroidina*, *Strophoconus*, *Textilaria*, and *Polymorphina*. See 'Annals Mag. Nat. Hist.,' ser. 4, vols. ix and x, 1872, "The Species figured by Ehrenberg."

General Characters.—An elongate, subcompressed, Buliminoid shell, asymmetrically biserial.

1. Virgulina Schreibersiana, *Czjzek*, 1848. Var. obesa, nov. Plate VI, fig. 20.

Virgulina Schreibersiana, *Czizek*, 1848. Haidingers Naturw. Abhandl., vol. ii, p. 147, pl. xiii, figs. 18—21 ("*Schreibersii*" on the plate).
Polymorphina longissima, *Costa*, 1856. Atti Accad. Pont., vol. vii, pl. xiii, figs. 22, 23.
— appula, *Idem*. Ibid., p. 286, pl. xviii, fig. 17.
Virgulina Schreibersana, *Egger*, 1857. Neues Jahrb. für 1857, p. 295, pl. xii, figs. 12—14.
Bulimina pupoides, var. compressa, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 63, pl. v, fig. 131.
Virgulina Schreibersii, *Parker and Jones*, 1862. Introd. Foram., Appendix, p. 311.
Bulimina Presli, var. (Virgulina) Schreibersii, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 375, pl. vx, fig. 18; pl. xvii, figs. 72, 73.
Virgulina Schreibersiana, *Reuss*, 1867. Sitzungsb. Akad. Wien, vol. lv, part 1, p. 96, pl. iv, figs. 4 *a, b*, 5.
— Schreibersi, *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anstalt, vol. iv, p. 63, pl. vii, fig. 15.

VIRGULINA SCHREIBERSII, *Schwager*, 1877. Bollet. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 39.
— SCHREIBERSIANA, *Brady*, 1884. Report 'Challenger,' p. 414, pl. lii, figs. 1—3.
— SCHREIBERSI, *Andreae*, 1884. Abhandl. geol. Specialk. Elsass-Lothr., vol. ii, pt. 3, p. 213, pl. ix, figs. 8, 9.
— SCHREIBERSII, *Malagoli*, 1887. Atti Soc. Nat. Modena (Rend.), ser. 3, vol. iii, p. 108, pl. i, fig. 5.
— SCHREIBERSIANA, *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 220.
— — *Egger*, 1893. Abh. k. Bay. Ak. Wiss., vol, xviii, part 2, p. 290, pl. viii, figs. 93 & 95.
— — *Goës*, 1894. K. Sv. Vet.-Akad. Handl., vol. xxv, No. 9, p. 48, pl. ix, figs. 459, 461—472.

Characters.—This specimen has a rather rough surface, apparently from the wearing away or the decay of the shell; the smaller end in particular may have become rounded by the loss of the sharp apex common in the species. Compared with Czjzek's figure 21, this individual bears a strong likeness to the type in the arrangement of chambers, although it differs in being thick with a subovoid outline. Its long inflated chambers, variously arranged, parallel with the axis of the shell or nearly so, are characteristically typical.[1]

The elongate forms of *Virgulina Schreibersiana* have been abundantly illustrated by the authors above referred to, but the shorter and thicker individuals have been rarely figured. Dr. A. Goës's fig. 464 is one of the few of this kind.

Occurrence.—*Virgulina Schreibersiana* is one of the most common of the Foraminifera, and is found in nearly all seas, and at all depths down to 3000 fathoms. It is common in the high latitudes of the Northern Hemisphere; but it has not apparently been recorded from correspondingly high latitudes of the Southern Ocean.

Its earliest recorded occurrences in the fossil condition are in the Chalk of Swanscombe and Taplow. We have not noticed its occurrence in the Eocene, but it has been recorded from the Oligocene of Elsass, from the Miocene of Italy and Vienna, and from the Pliocene of Italy and St. Erth.

The variety *obesa*, figured Pl. VI, fig. 20, is from the Coralline Crag of Sudbourne Hall, zone **d**.

[1] 'Annals Mag. Nat. Hist.,' ser. 4, vol. x, 1872, p. 186.

Genus 3.—Bolivina, *d'Orbigny*, 1839.

Brady, Report 'Challenger,' pp. 68 *and* 416.

Bolivina, *d'Orbigny, Reuss, Egger, Parker and Jones, Karrer, Carpenter, Brady, Schwager, von Hantken, Robertson, Vanden Broeck, Wright, Mariani, Malagoli, Berthelin, Terrigi, Möbius, Bronn, Costa, Egger, Andreae, Seguenza, Marsson, Toutkowsky, Zittel, Woodward and Thomas, Goës, Millett, Dervieux, de Amicis, Guppy, &c.*

Grammostomum, Strophoconus, Textilaria, Polymorphina, Proroporus, *Ehrenberg*. Brizalina, *Costa*.

General Characters.—Weak compressed modifications of *Bulimina*, distinctly biserial like *Textilaria*, but having the oblique unsymmetrical aperture of *Bulimina*.

1. Bolivina punctata, *d'Orbigny*, 1839. Plate III, figs. 3, 4.

Part I, 1866, Appendix II, Table, No. 69.

Bolivina punctata, *d'Orbigny*, 1839. For. Am. Mér., p. 63, pl. viii, figs. 10—12.
— antiqua, *Idem*, 1846. For. Foss. Vienne, p. 240, pl. xiv, figs. 11—13.
Grammostomum polystigma, *Ehrenberg*, 1854. Mikrogeologie, pl. xix, fig. 84.
— caloglossa, *Idem*, 1854. Ibid., pl. xxv, figs. 17, 18.
— polytheca, *Idem*, 1854. Ibid., pl. xxv, figs. 19, 20.
Bolivina antiqua, *Egger*, 1857. Neues Jahrb. für Jahrg., 1857, p. 294, pl. viii, figs. 22—26.
— punctulata, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 60 (Table).
— antiqua, *Karrer*, 1861. Sitzungsb. k. Ak. Wiss. Wien, vol. xlvi, p. 457.
— catanensis, *Seguenza*, 1862. Rhizopod. Foss. Pleist. Catania, p. 113, pl. ii, figs. 3, 3 *a*, 3 *b*.
— punctata, *Carpenter*, 1862. Introd. Foram., p. 197.
— — *Brady*, 1864. Tr. Linn. Soc., vol. xxiv, p. 468, pl. xlviii, fig. 9.
— — *Idem*, 1865. Nat. Hist. Trans. North. and Durham, vol. i, p. 103, pl. xii, fig. 8.
Bulimina Presli, var. (Bolivina) punctata, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 376, pl. xvii, fig. 74.
Bolivina punctata, *J., P., and B.*, 1866. Monogr. For. Crag, Appendix II, Table, No. 69, pl. iii, figs. 3, 4.
— antiqua, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 41.
— punctata, *Brady*, 1870. Ann. Nat. Hist., ser. 4, vol. vi, p. 302.
— elongata, *Hantken*, 1875. Mitth. Jahrb. Ung. Geol. Anstalt, vol. iv, p. 65, pl. vii, fig. 14.
— punctulata, *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, pl. o, fig. 63.
— antiqua, *Terrigi*, 1880. Atti Accad. Pont. Nuov. Lincei, Ann. xxxiii, p. 196, pl. ii, fig. 40.

Bulimina (Bolivina) punctata, *Goës*, 1882. K. Sv. V.-Ak. Handl., vol. xix, No. 4, p. 69, pl. iv. figs. 114—126.
Bolivina punctata, *Möbius*, 1880. Meeresfauna Mauritius, p. 94, pl. ix, figs. 9, 10
— — *Brady*, 1884. Report 'Challenger,' p. 417, pl. lii, figs. 18, 19.
Textularia inflata, *Andreae*, 1884. Abhandl. Geol. Spec.-Karti Elsass-Loth., vol. ii, Heft. 3, p. 306, pl. vi, figs. 6, 6 *a*, *b*.
Bolivina Melettica, *Andreae*, 1884. Ibid., pp. 527 and 262, pl. xi, fig. 5.
— punctata, *Woodward and Thomas*, 1885. Thirteenth Ann. Report Minnesota, p. 169, pl. iii, fig. 12.
— — *Sherborn and Chapman*, 1886. Journ. Roy. Microsc. Soc., ser. 2, vol. vi, p. 743, pl. xiv, figs. 10 *a*, *b*.
— — *Malagoli*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 375, pl. xiv, figs. 1—4.
— — *Fornasini*, 1889. Rhizopod. Plioc. Bologna, pl. o, fig. 5.
— — *Terrigi*, 1889. Atti Accad. Linc., ser. 4, vol. vi, p. 110, pl. v, fig. 8.
— — *Idem*, 1891. Mem. R. Com. Geol. Ital., vol. iv, part 1, p. 74, pl. i, figs. 26, 27.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 351.
— — *Egger*, 1893. Abh. k. Bay. Ak.-Wiss., vol. xviii, part 2, p. 298, pl. viii, figs. 1—3.
— — *Goës*, 1894. K. Sv. V.-Ak. Handl., vol. xxv, No. 9, p. 49, pl. ix, figs. 475—480.

Characters.—Shell straight or slightly curved; chambers very numerous, narrow, arcuate, neat. Foramina usually conspicuous.

There is a considerable range of variation, in minor particulars, amongst the feeble biserial forms of *Bulimina* included under the sub-type *Bolivina*. We can, however, find no single character in *B. antiqua* as figured by d'Orbigny, and subsequently by Egger, which can be said to form valid ground for even varietal separation from his previously described recent species *B. punctata*.

Occurrence.—*Bolivina punctata* is shown in the 'Challenger' and 'Gazelle' Reports to be a cosmopolitan species. Its bathymetrical range extends from 2 to 2740 fathoms. As a fossil it is of very common occurrence. It has been recorded from the phosphatic chalk of Taplow, the Eocene London Clay, the Oligocene of Elsass, the Miocene of Malaga, Italy, Vienna, and Muddy Creek (Victoria), and from the Pliocene of Italy, Garrucha (South Spain), and St. Erth. In the Coralline Crag it has been found in every zone examined.

2. Bolivina Ænariensis (*Costa*), 1856. Plate VI, fig. 21.

Brizalina Ænariensis, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 297, pl. xv, figs. 1 *a*, A, B.

Bolivina Ænariensis, *Brady*, 1882. Proceed. Roy. Soc. Edinb., vol. xi, p. 711, Table.
— — *Idem*, 1884. Report 'Challenger,' p. 423, pl. liii, figs. 10, 11.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 221, pl. xliii, figs. 2, 4, 5.
— — *Malagoli*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 377, pl. xiv, figs. 11, 12.

Characters.—Small, compressed, elongate, lanceolate in outline, with numerous regular, Textilariform, curved chambers. There are no external ornaments, such as the linear costulæ, which Brady noticed to be sometimes absent, and which are wanting in a specimen from the Abrohlos, 'Trans. Zool. Soc.,' 1888, pl. xliii, fig. 5. Individuals vary also in their relative width and length, as is shown in the same pl. xliii.

Occurrence.—Bolivina Ænariensis has been most commonly met with in dredgings from the North Atlantic, and is everywhere confined apparently to the littoral shallow zones. The greatest depth from which specimens have been recorded is 1630 fathoms in the Faroe Channel. Our earliest record of the species in a fossil condition is from the Miocene of Italy, and of Muddy Creek, Victoria. It has also been recorded from the Pliocene of Italy; and we have specimens in our own collections from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have specimens from every zone examined. The figured specimen is from Sudbourne Hall, zone **d.**

Sub-family 3.—Cassidulininæ.

Brady, Report '*Challenger,*' 1884, *pp.* 69, 427.

General Characters.—Test consisting of a Textilarioid series of alternating segments, more or less coiled on itself.

Genus 1.—Cassidulina, *d'Orbigny*, 1826.

Cassidulina, *d'Orbigny, Sander-Rang, Menke, Bronn, Reuss, Schultze, Egger, Parker and Jones, Williamson, Carpenter, Brady, M. Sars, Parfitt, Alcock, Winther, Schulze, G. M. Dawson, von Hantken, Seguenza, Wright, Norman, Bütschli, Terrigi, Franzenau, Hartwig, Greene, Zittel, Schwager, Nicholson, Schlumberger, Quenstedt, Basset, Karrer, Andreae, Sherborn, Chapman, Guppy, &c.*

GLOBIGERINA, *d'Orbigny.*
BURSEOLINA, *Seguenza.*
STROPHOCONUS and MEGATHYRA, *Ehrenberg.*

General Characters.—Test lenticular, oblong or ovate, biserial, folded on its long axis, and coiled more or less completely on itself; rarely dimorphous. Chambers elongate, curved; the two series alternating, and the principal part of the exposed chambers turned towards opposite sides of the shell. Aperture a curved slit extending to the middle of the septal plane.

1. CASSIDULINA LÆVIGATA, *d'Orbigny*, 1826. Plate IV, figs. 15 *a*, *b*.

Part I, 1866, Appendix II, Table, No. 70.

CASSIDULINA LÆVIGATA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 282, No. 1, pl. xv [vi by error in the text], figs. 4 and 5; Modèle, No. 41.
— PULCHELLA, *d'Orbigny*, 1839. Foram. Amér. Mérid., p. 57, pl. viii, figs. 1—3.
— LÆVIGATA, *Cuvier*, 1846? Regne Anim. (1836–46), vol. ix, p. 33, pl. xv, fig. 3.
— — *Reuss*, 1846. In Geinitz's Grundr. Verstein., p. 660, pl. xxiv, fig. 42.
— PUNCTATA, *Reuss*, 1849. Densksch. k. Akad. Wiss. Wien, vol. i, p. 376, pl. xlviii, figs. 4 *a*, *b*.
— LÆVIGATA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 295, pl. xi, figs. 17 and 18.
— — *Williamson*, 1858. Rec. Brit. Foram., p. 68, pl. vi, figs. 141 and 142.
— — *Morris and Quekett*, 1860. Catal. Hunterian Mus., p. 92, A. 34.
— SICULA, *Seguenza*, 1862. Atti Accad. Gioenia, ser. 2, vol. xviii, p. 111, pl. i, figs. 7, 7 *a*.
— LÆVIGATA, *Sars*, 1864. Foss. Dyrelevn. Qvarterper., pp. 62, 68, &c.
— — *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 25, pl. ii, fig. 67.
— — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 377, pl. xv, figs. 1—4; pl. xvii, figs. 64 *a*—*c*.
— — *Brady*, 1865. Nat. Hist. Trans. Northumb. and Durham, vol. i, p. 104, No. 1.
— — *Parker, Jones, and Brady*, 1866. Monogr. Foram. Crag, Appendix II, Table, No. 76, pl. iv, figs. 15 *a*, *b*.
— — *Hartwig*, 1866. The Sea, 3rd edit., p. 381, fig. *e*.
— — *Sars*, 1868. Vidensk-Selsk. Forhandl. for 1868, p. 249.
— — *G. M. Dawson*, 1870. Canad. Nat., n. s., vol. v, p. 179.

CASSIDULINA LÆVIGATA, *Greene*, 1871. Manual Protozoa, p. 15, fig. 3 *e*.
— — *Zittel*, 1876. Handb. Palæont., part 1, p. 91, fig. 29.
— — *Figuier*, 1873. Ocean World, p. 84, fig. 21.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, pl. o, fig. 67.
— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 116, fig. 18 *m*.
— — *Terrigi*, 1880. Atti Accad. Pont. N. Lincei, vol. xxxiii, p. 199, pl. ii, fig. 47.
— — *Schlumberger*, 1882. Feuille Jeun. Nat., part 1, fig. 15.
— — *Jones*, 1884. In Microgr. Dict., 4th edit., p. 136, pl. xxiii, figs. 45 *a*, *b*.
— — *Brady*, 1884. Report 'Challenger,' p. 428, pl. liv, figs. 1—3.
— — *Quenstedt*, 1885. Handb. Petref., 3rd edit., part 5, p. 1059, pl. lxxxvi, fig. 59.
— — *Basset*, 1885. Ann. Soc. Sci. Charente-Inf., p. 162, fig. 41.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 221, pl. xliii, fig. 11.
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 111, pl. v, fig. 9.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 276, 302, pl. vii, figs. 47, 48, 54—56.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 43, pl. viii, figs. 418—420.

Characters.—Nearly circular, biconvex, with thin edge, sometimes partially keeled; long, curved, very slightly inflated chambers.

Authors seem well agreed as to the characters of the typical *Cassidulina lævigata*. *C. punctata* of Reuss does not appear to present any peculiarities necessitating varietal separation; and the number and size of the pseudopodial apertures vary in different individuals of almost every species of hyaline Foraminifera, and, indeed, alter with the age of the shell; and it is on these foramina rather than any more important data that Prof. Reuss has depended for its diagnosis. For the same reasons the *C. sicula* of Seguenza is included. Professor Williamson was probably right in regarding *C. pulchella* of d'Orbigny as a representative of modifications having no morphological significance unless present to a much greater degree than shown in the figures of the South-American specimen.

Occurrence.—*Cassidulina lævigata* is most frequently found in the temperate, arctic, and antarctic seas; but it is not confined to those latitudes. Its bathymetrical range extends from 60 to 1675 fathoms.

Its earliest recorded appearance as a fossil is from the London Clay of the Isle

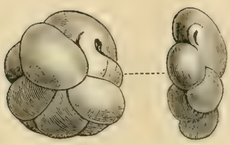
of Wight (Brady). It has also been met with in the Miocene of Vienna, and of Muddy Creek, Victoria; in the Pliocene of Italy and St. Erth; and in the Pleistocene of Norway, Ireland, and Ischia. We have also in our own collections numerous specimens from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have specimens from nearly every zone examined.

2. Cassidulina crassa, *d'Orbigny*, 1840. Plate IV, fig. 16 (var. *oblonga*); woodcut fig. 18 (*crassa*).

Part I, 1866, Appendix II, Table, Nos. 71 and 72.

Polymorpha tuberosa et globulifera, *Soldani*, 1791. Testaceographia, vol. i, pt. 2, p. 117, pl. cxxiii, fig. k.
Globigerina elongata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 277, No. 4.
Cassidulina crassa, *d'Orbigny*, 1840. Foram. Amér. Mérid., p. 56, pl. vii, figs. 18—20.
— — *Idem*, 1846. For. Foss. Vien., p. 213, pl. xxi, figs. 42, 43.
— oblonga, *Reuss*, 1850. Denkschr. k. Ak. Wiss. Wien, vol. i, p. 376, pl. xlviii, figs. 5, 6.
— — *Egger*, 1857. Neues Jahrb. für Jahrg. 1857, p. 295, pl. xi, figs. 1—3.
— lævigata (in part), *Parker and Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 295, pl. xi, fig. 18.
— obtusa, *Williamson*, 1858. Rec. For. Gt. Brit., p. 69, pl. vi, figs. 143, 144.
— crassa, *Bronn*, 1859. Klass. Ordn. Thier-Reichs, part 1, p. 69, fig. 6.
— — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 152, Table.
— oblonga, *Iidem*, 1860. Ibid., p. 302, No. 153, Table.
— crassa, *Carpenter*, 1862. Introd. Foram., p. 198.
— lævigata, var. crassa, *Parker and Jones*, 1862. In Carpenter's Introd., App., p. 311.
— — — *Iidem*, 1865. Phil. Trans., vol. clv, p. 377, pl. xv, figs. 5—7; pl. xvii, fig. 64 *d*.
— obtusa, *Alcock*, 1865. Proc. Lit. and Phil. Soc. Manchester, vol. iv, p. 206.
— crassa, *Reuss*, 1865. Model, No. 43 (Catal., 1861, No. 81).
— oblonga, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendix II, No. 71, pl. iv, fig. 16.
— crassa, *Iidem*, 1866. Ibid., No. 72.
— — *G. M. Dawson*, 1870. Canad. Nat., n. s., vol. v, p. 179.
— oblonga, *Parker, Jones, and Brady*, 1871. Ann. Nat. Hist., ser. 4, vol. viii, p. 175, pl. xi, fig. 129.

CASSIDULINA CRASSA, *Bütschli*, 1880. In Bronn's Klass. Thier-Reichs, p. 205, pl. viii, fig. 6.
— — *Terrigi*, 1883. Atti Accad. Pont. N. Lincei, vol. xxxv, p. 192, pl. iii, fig. 34.
— — *Brady*, 1884. Report 'Challenger,' p. 429, pl. liv, figs. 4, 5.
— — *Andreae*, 1884. Abhandl. geol. Specialk. Elsass-Lothringen, vol. ii, part 3, p. 235, pl. x, figs. 31, 32.
— — *Egger*, 1893. Abhandl. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 276, 303, pl. vii, figs. 35, 36.
— OBLONGA, *Idem*. Ibid., figs. 33, 34.
— CRASSA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 43, pl. viii, figs. 421, 422.



FIGS. 18 *a, b*. *Cassidulina crassa*, d'Orb. × 24. From the 'Phil. Trans.,' vol. clv, pl. xv, figs. 6 and 7.

Characters.—Shell ovate-oblong, biconvex, but more or less compressed; margin obtuse or rounded. It is smaller and relatively thicker than *Cassidulina lævigata*, and the segments are fewer and comparatively short and inflated.

C. crassa, var. *oblonga* (Pl. IV, fig. 16), is an asymmetrical varietal modification usually smaller than the type; it indicates a possible line of divergence, but not of much zoological importance. Dr. Egger (whose work in 1893 on the Foraminifera collected by the 'Gazelle' is referred to above) does not agree with this amalgamation of the Cassiduline varieties (p. 303).

Occurrence.—*Cassidulina crassa* has a world-wide range, and has been recorded from depths ranging from 40 fathoms in the North Pacific down to 2760 fathoms in the North Atlantic.

The earliest recorded appearance of the species in a fossil condition is in the Miocene of Vienna. It has been found in the Pliocene of Italy and St. Erth; and we have in our own Collection specimens from the Casterlian and Scaldisian of Antwerp. So far as the Crag is concerned, we have nothing to add to the record given in the First Part of the Monograph.

Cassidulina oblonga.—This variety appears only to have been met with in a fossil condition. The formations in which it has been found are the Oligocene of Elsass, the Miocene of Vienna, and the Pliocene of Garrucha (South Spain) and St. Erth. So far as the Crag is concerned, we have nothing to add to the record in the First Part of the Monograph.

Family 3.—LAGENIDÆ.

Brady, Report ‘*Challenger*,’ 1884, *pp.* 69 *and* 439.

General Characters.—Test finely perforated, either monothalamous or polythalamous; in the latter case in a straight, curved, spiral, or alternating series of segments. Aperture simple or radiate, terminal. No canal-system.

Sub-family 1.—LAGENINÆ.

Brady, Report ‘*Challenger*,’ 1884, *pp.* 69 *and* 440.

General Characters.—Test monothalamous; ecto- or ento-solenian.

Genus 1.—LAGENA, *Walker and Jacob*,[1] 1784.

Brady, Report ‘*Challenger*,’ 1884, *pp.* 69 *and* 440.

Part I, 1866, page 28.

Additional Synonyms:

Orthocerata globularia, &c., Flosculi, Polymorpha, Sphærulæ siphunculatæ, hispidæ, &c., Globuli zoophytici, Ossicula Madreporaria, Testæ ovales, oviformes, glandiformes, fusiformes, &c., *Soldani*.[2]
HOLOCOCCUS? *Ehrenberg.*

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[1] The authorship of the species usually ascribed to "Walker and Jacob" is considered at length in a note at page 28 of Part I, 1866.

[2] In the 'Bolletino Soc. Geol. Italiana,' vol. v, 1886, pp. 132—254, Signor C. Fornasini carefully and clearly indicated to what modern genera and species of Foraminifera those figured by Soldani in his great work, 'Testaceographia,' &c., 1779—1798, have been with some probability assigned. Of the *Lagenæ* the following are recognised:

Lagena sulcata, *W. and J.* Pages 150, 209, 213, and 225.
— melo, *d'Orb.* Page 194.
— squamosa, *Montagu.* Page 209.
— globosa, *Montagu.* Page 226.
— lævis, *Montagu.* Pages 229, 230.
— gracillima, *Seguenza.* Page 236.
— hispida, *Reuss.* Pages 236, 237.

Amygdalites, *Costa.*

After Oolina add *Ehrenberg, Diesing, Czjzek, Karrer, Kübler and Zwingli.*

Ovolina, *Terquem.*

After Ovulina add *Schafhäutl.*

Ovulida? *Folin.*

After Lagena add *Harvey and Bailey, Gümbel, Stache, Karrer, Czjzek, Schwager, von Hantken, F. W. O. R. Jones, Kübler and Zwingli, Terquem and Berthelin, Fornasini, Bütschli, Fischer, Alcock, Sherborn and Chapman, Haeusler, Mariani, Balkwill and Millett, Wright, Deecke, Mackie, Seguenza, Vine, A. Agassiz, Gruber, Dunikowski, Tate and Blake, Brown, von Schlicht, Terrigi, Toutkowsky, Fric, Green, Prestwich, Morris, Malagoli, Kaufmann, Marsson, Schlumberger, Quenstedt, Steinmann, Gosse, Hartwig, Greene, Möbius, Rzehak, Dawson, Nicholson, Toll, Stache, Siddall, Cooke, Andreae, Wallich, Wood, Chimmo, Folin, Neumayr, Egger, Goës, Guppy, Millett, and others.*

After Lagenula add *Zborzewski.*

Lagenulina, *Terquem.*

After Entosolenia add *Möbius, Reuss, Dawson, Cooke, Chimmo, Schulze, Gosse, Parker and Jones, Schlumberger, Alcock.*

After Fissurina add *Pictet, Franzenau, Terquem, Karrer, Schwager, Bornemann, von Schlicht.*

Cenchridium, *Ehrenberg, Zwingli and Kübler.*

Capitellina, *Marsson.*

General Characters.—Test consisting of a single chamber, globose, variously compressed, or tubular, with one terminal aperture (rarely two); aperture round or slit-like, trifid or stellate; level with the surface, or produced (ectosolenian), or continued inwards (entosolenian). See Report, 'Challenger,' p. 441, figs. 11 *a—m.* Surface smooth or ornamented.

The species and sub-species of *Lagena* will be here described according to the systematic order adopted in the Report of the 'Challenger,' &c., pp. 440 *et seq.*

Although all the known forms of *Lagena* may be *biologically* referred to one species (so numerous and perfect are the gradations from one variety to another), yet they may be divided, as a "generic series, into sections grouped round a few subtypical forms," most of which have their many varieties and sub-varieties. These are set out in a large scheme or classified list in the Report 'Challenger,' &c., pp. 444—449, and the following Table gives the result in a condensed form.

Table of the Arrangement of the Lagenæ. After Dr. H. B. Brady's Scheme, 1884.

Form.	*Surface.*	*Sub-types or Species.*
I. Round in transverse section	1. Smooth	*L. globosa.* *L. lævis.*
	2. Rough.	*L. aspera.*
	3. Prickled.	*L. hispida.*
	4. Striate.	*L. striata.*
	5. Costate.	*L. sulcata.*
	6. Partly costate.	*L. semistriata.*
	7. Costate and perforate.	*L. striato-punctata.*
	8. Reticulate and perforate.	*L. Hertwigiana.*
	9. Reticulate.	*L. squamosa.*
II. Compressed on two or more sides......	1. Angle-edged.	*L. lævigata.*
	2. Keeled.	*L. marginata.*
	3. Bi- or tri-carinate.	*L. Orbignyana.*

1. Lagena globosa (*Montagu*), 1803. Plate I, fig. 32.

Part I, 1866, p. 32; and Appendix I, Table, No. 34, Appendix II, No. 24.

Additional Synonyms:[1]

Ossicula *Madreporaria*, *Soldani*, 1796. Testaceographia, vol. i, part 3, p. 245, pl. clxxii, figs. B, C, D, E?

Lagena globosa, *Brown*, 1844. Illustr. Rec. Conch. Gt. Brit., ed. 2, p. 144, pl. lvi, fig. 37.

— — *Williamson*, 1848. Mem. Lit. Phil. Soc. Manchester, ser. 2, vol. viii, p. 47, pl. [3], fig. 39.

Phialina oviformis, *Costa*, 1856. Atti Accad. Pont. Linc., vol. vii, fasc. 2, p. 123, pl. xi, figs. 8, 9.

"Miliola, Holococcus, Panderi (Trochiliscus, *Pander*)"? *Ehrenberg*, 1858. Monatsber. k. preuss. Ak. Wiss. für 1858, p. 311; and 1863; ibid. for 1862, p. 601, pl. o, fig. 11 (fragment, Devonian). Seguenza's *Fissurina aperta*, Mioc. Mon. Mess., 1862, p. 60, pl. i, fig. 60, is very much like Ehrenberg's figure.

Entosolenia globosa, *J. W. Dawson*, 1859. Canad. Nat., vol. iv, p. 28, figs. 4, 5 (apiculate).

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[1] In the fifteenth line of the synonyms at p. 32, Part I, *instead of* Ib. *read* 'Ann. Mag. Nat. Hist.,' ser. 2.

LAGENA GLOBOSA, *Reuss*, 1863. Sitzungsb. k. Akad. Wiss. Wien, vol. xlvi, p. 318, pl. i, figs. 1—3.

— — *Idem*, 1863. Bull. Acad. Roy. Belg., ser. 2, vol. xv, p. 143, pl. i, figs. 13, 14.

— AARGOVENSIS, *Kübler and Zwingli*, 1866. Neuesjahrsblatt, &c., p. 12, pl. ii, fig. 10, var. *major*; fig. 11, var. *minor*.

— GLOBOSA, *Mackie*, 1867. Science Gossip, 1867, p. 129, fig. 105.

ENTOSOLENIA GLOBOSA, *Cooke*, 1869. Thous. Obj. Microsc., p. 91, pl. ix, fig. 15.

LAGENA GLOBOSA, *Terquem*, 1870. Mém. Acad. Imp. Metz, vol. li, p. 351, pl. xxv, figs. 24—26.

CENCHRIDIUM AARGOVENSE, *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 13, pl. ii, i, fig. 1 ([var. *major*] long variety), and fig. 2 [var. *minor*].

LAGENA PARKINSONI, *Iidem*, 1870. Ibid., p. 17, pl. ii, III, fig. 1.

— MINUTISSIMA, *Iidem*, 1870. Ibid., pp. 19, 21, pl. ii, IV, fig. 1.

ENTOSOLENIA GLOBOSA, *G. M. Dawson*, 1870. Canad. Nat., New Ser., vol. v, p. 178.

— — *J. W. Dawson*, 1872. Ibid., vol. vi, p. 254, pl. iii, fig. 2 (part).

LAGENULINA GLOBOSA, *Terquem*, 1876. Plage Dunkerque, p. 67, pl. vii, figs. 3, 4.

LAGENA GLOBOSA, *Brady and Robertson*, 1876. Rep. Brit. Assoc. for 1875, p. 189.

ENTOSOLENIA GLOBOSA, *Schulze*, 1877. Arch. Mikrosk. Anat., vol. xiii, p. 9, pl. ii, figs. 1—3 (structural).

LAGENA GLOBOSA, *Vine*, 1878. Science Gossip, vol. xiv, p. 52, fig. 26.

— ELONGATA, *Dunikowski*, 1879. Nowe Foram. &c., Kosmos [Lemberg], vol. iv, p. 105, pl. o, fig. 2 (long ovoid).

— MAXIMA, *Idem*, 1879. Ibid., p. 105, fig. 3.

— GLOBOSA, *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 2.

— — *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, p. 26, pl. ix, fig. 7.

ENTOSOLENIA GLOBOSA, *Jones*, 1883. Micrógr. Dict., ed. 4, p. 290, pl. xxiii, figs. 23 *a*, *b*.

LAGENA GLOBOSA, *Terrigi*, 1883. Atti Accad. Pont. N. Lincei, vol. xxxv, p. 170, pl. ii, fig. 3.

— — *Brady*, 1884. Report 'Challenger,' p. 452, pl. lvi, figs. 1—3.

— — and var., *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 744, pl. xiv, figs. 11, 12.

— — *Terquem*, 1886. Mém. Soc. Géol. France, ser. 3, vol. iv, p. 6, pl. i, fig. 6.

— — *Uhlig*, 1886. Jahrb. k. k. Geol. Reichsanst., vol. xxxvi, p. 167, fig. 1.

ENTOSOLENIA GLOBOSA, *J. W. Dawson*, 1886. Handb. Zool., ed. 3, p. 43, fig. 31.

LAGENA GLOBOSA, *Haeusler*, 1887. Neues Jahrb. f. Min. for 1887, part 1, pp. 181, 189, pl. iv, figs. 1—18, and pl. v, figs. 19—28 (initial chambers of *Nodosaria radicula*).

— — *Brady*, 1888. Geol. Mag., dec. 3, vol. v, pp. 444, 481, pl. xiii, figs. 1—3.

LAGENA GLOBOSA, *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vii, p. 111, pl. v, fig. 10; pl. vi, figs. 4—6.
— — *Mariani*, 1889. B. S. Geol. Ital., vol. vii, p. 285, pl. x, figs. 3, 4.
— — *Frič*, 1889. Arch. Nat. Landesd. Böhmens, vol. vii, p. 110, woodcut 155.
— — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 77, pl. ii, fig. 1.
— — *Meriani*, 1892. Boll. Soc. Geol. Ital., vol. x, p. 725, pl. i, fig. 7.
— — *Idem*, 1893. Ann. Istit. Tecn. Udina, ser. 2, ann. xi, p. 22 (sep. copy), pl. i, fig. 7.
— — *Egger*, 1893. Abhandl. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 320, 323, pl. x, fig. 69.
— — *Chapman*, 1893. Journ. R. Microsc. Soc. for 1893, p. 579, pl. viii, figs. 1 *a*, *b*.
— — *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 77, pl. xiii, fig. 741 (with synonyms).
— — *Chapman*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 705.

Characters.—Test globular, subglobular, elliptical, ovoid, or pyriform, smooth; aperture with an entosolenian neck and a variable orifice.

Occurrence.—*Lagena globosa* is found in all seas without restriction as to latitude or depth. It is also of wide distribution in a fossil condition. It is recorded from the Upper Silurian (Brady); from the Jurassic of Switzerland; from the Lower Cretaceous (Bargate beds) of Surrey; Gault, Folkestone; Red Chalk, Speeton; Upper Chalk, Taplow, Ireland, and Maestricht; from the Eocene, London Clay; from the Oligocene of Elsass and Pietzpuhl; from the Miocene of Muddy Creek, Victoria; from the Pliocene of St. Erth and Belgium (Casterlian and Scaldisian) and Piedmont; and from the Pleistocene generally. In the Coralline Crag *L. globosa* occurs in nearly all the exposures examined, but it is rare.

2. LAGENA APICULATA, *Reuss*, 1850. Plate I, fig. 27.

Part I, 1866, p. 44; and Appendix II, Table, No. 33.

Additional Synonyms:

MILIOLA CAUDATA, *Ehrenberg*, 1854. Mikrogeologie, pl. xxix, fig. 46.
LAGENA APICULATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 44, pl. i, fig. 27.
OOLINA LIASSICA, *K. and Z.*, 1866. Neujahrbl., &c., p. 57, pl. i, fig. 15
LAGENA BULLÆFORMIS, *Schwager*, 1868. Pal. Beitr., vol. i, p. 655, pl. xxxiv, fig. 5.
— Nos. 11—17, 19, 21, 23, *Schlicht*, 1870. Pietzpuhl, pp. 4—6, pls. i, ii.
— VULGARIS, var. APICULATA, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 50, pl. xix, figs. 3—5.

LAGENA APICULATA, *Terquem*, 1870. Mém. Acad. Imp. Metz, vol. li, p. 350, pl. xxv, figs. 22, 23.
— — *Hantken* [1876], 1881. Mitth. Jahrb. Ungar. Geol. Anst., vol. iv, p. 22, pl. xii, fig. 7 (1876 in Hungary).
— CAUDATA, *Brady and Robertson*, 1876. Rep. Brit. Assoc. for 1875, p. 190.
— MAXIMA, *Dunikowski*, 1879. Kosmos (Lemberg), vol. iv, p. 105, fig. 3.
— APICULATA, *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, pl. vii, fig. 3.
— — *Brady*, 1884. Report 'Challenger,' pp. 444, 453, pl. lvi, figs. 4, 15—18.
— — *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc., ser. 2, vol. vi, p. 744, pl. xiv, fig. 14.
— — *Terquem*, 1886. Mém. Soc. Géol. France, ser. 3, vol. iv, p. 6, pl. i, fig. 5.
— — *Haeusler*, 1887. Neues Jahrb. f. Min., &c., for 1887, part 1, p. 182, pl. iv, figs. 19—30; and pl. v, figs. 36, 37.
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 111, pl. v, fig. 11.
— — *Mariani*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 285, pl. x, fig. 5.
— — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 555, pl. ix, figs. 6, 7, 9—11.
— — var. ODONTOSTOMA, *de Amicis*, 1893. Ibid., vol. xii, fasc. 3, p. 352, pl. iii, figs. 9 *a*, *b*.
— — *Egger*, 1893. Abhandl. Bayer. Ak. Wiss., vol. xviii, part 2, pp. 321, 324, pl. x, fig. 8.
— — *Chapman*, 1893. Journ. R. Microsc. Soc. for 1893, p. 581, pl. viii, figs. 2 *a*, *b*, and figs. 3 *a*, *b*. [Elongate and globose forms.]
— — var. EMACIATA, *Idem*, 1893. Ibid., figs. 4 and 7.
— — *Idem*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 705.
— — *Goës*, 1894. K. Sv. Vet.-Akad. Handl., vol. xxv, No. 9, p. 80, pl. xiii, fig. 747.

Characters.—Entosolenian and otherwise, also like *L. globosa*, but pointed, instead of round, at the base.

Occurrence.—*Lagena apiculata* is a cosmopolitan form, found in all latitudes, and at all depths from the littoral zone to 2750 fathoms. As a fossil it is also very widely distributed. It has been recorded from the Lias; from the Neocomian Beds of Surrey; from the Gault of Folkestone; from the Eocene, London Clay; from the Oligocene of Elsass; from the Miocene of Messina; and from the Pliocene of Italy and St. Erth. In the Coralline Crag it has been met with at Sutton only.

3. LAGENA LÆVIS (*Montagu*), 1803. Plate I, fig. 28.

Part I, 1866, p. 33; and Appendix II, Table, No. 25.

Additional Synonyms:

Testæ oviformes, glandiformes, fusiformes, &c., *Soldani*, 1798. Testaceographia, &c., vol. ii, pp. 16, 17, pl. iii, figs. *ee*, *ll*, *rr*; and pl. iv, fig. *ss*.
PHIALINA PYRIFORMIS, *Costa*, 1856. Atti Accad. Pont., vol. vii, fasc. 2, p. 123, pl. xi, fig. 6, var. fig. 10.
LAGENA LÆVIS, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 33, pl. i, fig. 28.
— — *Mackie*, 1867. Science Gossip for 1867, p. 130, fig. 112.
— [— var.] ANTIQUA, *Alcock*, 1868. Mem. Lit. Phil. Soc. Manchester, ser. 3, vol. iii, p. 176, pl. iv, fig. 3.
— — *G. M. Dawson*, 1870. Can. Nat., n. s., vol. v, p. 178.
— Nos. 26—29, *Schlicht*, 1870. Pietzpuhl, pp. 6, 7, pl. ii, figs. 3, 7, 8, 11.
— VULGARIS, *Terquem*, 1870. Mém. Ac. Imp. Metz, p. 349, pl. xxv, figs. 20, 21.
— HELVETICA, *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 24, pl. iii, fig. 1; and p. 33, pl. iv, Impressathon, fig. 1.
— BADENSIS, *Iidem*, 1870. Ibid., p. 38, pl. iv, Bed.-Sch., fig. 1.
— VULGARIS, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 51, pl. xix, figs. 10, 12, 13.
— — var. BICAMERATA, *Idem*, 1872. Ibid., p. 65, pl. xix, figs. 60, 61.
— — *Terquem*, 1875. Plage Dunkerque, p. 21, pl. i, fig. 3.
— — *Terquem and Berthelin*, 1875. Mém. Soc. Géol. Fr., ser. 2, vol. x, p. 13, pl. xi, figs. 6 *a*, *b*.
— LÆVIS, *Morris*, 1876. Lect. Geol. Croydon, p. 8, fig. 3 *b*.
— — *Brady and Robertson*, 1876. Brit. Assoc. Rep. for 1875, p. 189.
— — *Terrigi*, 1880. Atti Acc. P. N. Lincei, vol. xxxiii, p. 176, pl. 1, fig. 4.
— — *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 21.
— — *Green*, 1881. Amer. Journ. Microsc., vol. vi, p. 46, pl. o, fig. 1.
— VULGARIS, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 25, pl. ix, figs. 3—6.
— LÆVIS, *Jones*, 1883. Microgr. Dict., ed. 4, p. 452, pl. xxiii, figs. 22 *a*, *b*.
— — *Brady*, 1884. Rep. 'Chall.,' pp. 444, 455, pl. lvi, figs. 7—14 and 30.
— — *Jones*, 1884. Quart. Journ. Geol. Soc., vol. xl, p. 769, pl. xxxiv, fig. 3.
— — *Sherborn and Chapman*, 1886. Journ. Roy. Micros. Soc., ser. 2, vol. vi, p. 744, pl. xiv, fig. 13.
— VULGARIS, *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. iv, p. 6, pl. vii, fig. 4.
— LÆVIS, *Haeusler*, 1887. Neues Jahrb. for 1887, part 1, p. 181, pl. iv, figs. 31—50; pl. v, figs. 31—35 (two-chambered) and 53.

Lagena lævis, *Malagoli*, 1887. Atti Soc. Nat. Modena (Rend.), ser. 3, vol. iii, p. 109, pl. i, fig. 7.
— — *Brady*, 1888. Geol. Mag., dec. 3, vol. v, p. 481, pl. xiii, figs. 6—10 (including *L. antiqua*, Alcock).
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 112; pl. v, fig. 12; pl. vi, figs. 2, 3.
— — *B., S., and B.*, 1890. Journ. Roy. Micr. Soc., p. 555, pl. ix, fig. 3.
— cincta, *Iidem*, 1890. Ibid., fig. 5.
— lævis, *Fornasini*, 1890. Mem. Accad. Sci. Istit. Bologna, ser. 4, vol. x, p. 466, pl. o, fig. 1.
— — *Idem*, 1893. Ibid., ser. 5, vol. iii, p. 431, pl. ii, fig. 1 (= *Phialina propinqua*, Seguenza).
— — *Meriani*, 1892. B. S. Geol. Ital., vol. x, p. 725, pl. xxi, fig. 9.
— — — 1893. Ann. R. Istit. Udina, ser. 2, ann. xi, p. [22], pl. i, fig. 8.
— — *Chapman*, 1893. Journ. R. Microsc. Soc. for 1893, p. 581, pl. viii, fig. 5.
— — *Idem*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 705.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, pp. 321, 323, pl. x, figs. 3—5.
— tubulifera, *Egger*, 1893. Abh. k. Bayer. Ak., vol. xviii, pt. 2, p. 324, pl. xxi, fig. 9.
— lævis, *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 74, pl. xiii, figs. 719—722.

Characters.—Flask-like, with globular, oval, pyriform, or subfusiform body, and a produced tubular neck; smooth.

Occurrence.—*Lagena lævis* is one of the most common of the *Lagenæ*. It is found in all latitudes and at all depths. Its earliest recorded occurrence in a fossil condition is in the Wenlock Limestone (Upper Silurian, Brady). It has also been found in the Lower Lias of Yorkshire (Blake); in the Middle Lias of France; in the Jurassic of Switzerland (Kübler); in the Neocomian (Bargate Beds) of Surrey; in the Gault of Folkestone; in the Red Chalk of Speeton; in the Upper Chalk of Taplow, Ireland, and Maestricht; in the London Clay; in the Calcaire Grossier of the Paris Basin, in the Oligocene of Elsass and Pietzpuhl; in the Miocene of Piedmont; in the Pliocene of St. Erth, Belgium (Casterlian and Scaldisian), Garrucha (South Spain), and Piedmont. In the Coralline Crag *L. lævis* occurs in all the exposures examined, but rarely, and the specimens are small.

4. Lagena clavata (*d'Orbigny*), 1846. Plate VII, fig. 5.

Oolina clavata, *d'Orbigny*, 1846. Foram. Foss. Vien., p. 24, pl. i, figs. 2, 3.
Ovulina clava, *Ehrenberg*, 1854. Mikrogeol., pl. xxxii, II, fig. 2 *b*.

Lagena vulgaris, var. clavata, *Williamson*, 1858. Rec. Foram. Great Britain, p. 5, pl. i, fig. 6.

— clavata, *Mackie*, 1859. Recreat. Science, vol. i, p. 148, fig. 13.

— acicula, *Reuss*, 1860. Sitz. k. Ak. Wiss. Wien, vol. xlii, p. 355, pl. i, fig. 1.

— clavata, *Reuss*, 1863. Sitz. k. Ak. Wiss. Wien, vol. xlvi, part 1, p. 320, pl. i, figs. 13, 14 (var. *acicularis*).

— lævis, *Blake*, 1876. York. Lias, p. 453, pl. viii, fig. 7 (very short).

— clavata, *Terquem*, 1882. M. S. G. Fr., ser. 3, vol. ii, p. 25, pl. ix, fig. 2.

— — *Brady*, 1884. Report 'Challenger,' pp. 444, 456.

— — — 1888. Geol. Mag., dec. 3, vol. v, p. 481, pl. xiii, figs. 4 (?), 5.

— — *Egger*, 1893. Abhandl. k. bayer. Ak. Wiss., vol. xviii, part 2, pp. 321, 324, pl. x, fig. 68.

— — *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 75, pl. xiii, figs. 725—727.

Characters.—Long-necked, flask-shaped, phyaline, or fusiform, more or less pointed at the base; smooth.

Occurrence.—*Lagena clavata* appears to have been found by the 'Challenger' at one station only, namely, that off Heard Island in the South Atlantic, at a depth of 75 fathoms, in a bottom of black mud. Its geological range is extensive, though not many occurrences have been recorded. It has been found in the Upper Silurian (Brady); the Lias of Yorkshire (Blake); the Miocene of Vienna; and the Pliocene of Belgium, Garrucha (South Spain), and St. Erth. In the Coralline Crag we have found it at Sutton only, zone **f**.

5. Lagena gracillima, *Seguenza*, 1862. Plate I, figs. 36, 37.

Part I, 1866, p. 45; and Appendix II, Table, No. 34.

Additional Synonyms:

Testæ ovales, oliviformes, pyriformes, fusiformes, &c., *Soldani*. Testaceogr., vol. ii, p. 37, pl. xii, fig. Q.

Amphorina gracilis, *Costa*, 1856. Atti Accad. Pont., vol. vii, fasc. 2, p. 121, pl. xi, fig. 11.

Nodosaria? *Schwager*, 1866. Novara-Reise, Geol. Th., vol. ii, p. 236, pl. vi, fig. 75.

Lagena gracillima, *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 45, pl. i, figs. 36, 37.

— — *Brady*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 292, pl. i, figs. 6 *a*—*c*.

— — *G. M. Dawson*, 1871. Amer. Journ. Sci., ser. 3, vol. i, p. 206, fig. 10; Ann. Mag. Nat. Hist., ser. 4, vol. vii, p. 87, fig. 10.

LAGENA VULGARIS, sub-var. DISTOMA-POLITA, *O. Jones*, 1872. Tr. Linn. Soc. vol. xxx, p. 64, pl. xix, figs. 55—57.
— GRACILLIMA, *Brady and Robertson*, 1876. B. Assoc. Rep. for 1875, p. 189.
— — *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, pl. vii, fig. 20.
— — *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 185, pl. ii, fig. 5.
— — *Brady*, 1884. Report 'Challenger,' pp. 444 and 456, pl. lvi, figs. 19—28.
Indet., *De Folin*, 1877. Le Naturaliste, vol. ix, p. 140, fig. 20 *b*.
DENTALINA COMMUNIS (with shrunken septa), *Haeusler*, 1887. Neues Jahrb. for 1887, part 1, p. 189, pl. v, fig. 50.
LAGENA GRACILLIMA, *Egger*, 1893. Abhandl. k. bayer. Akad. Wiss., vol. xviii, part 2, p. 330, pl. x, fig. 12.
— — *Chapman*, 1893. J. R. Micr. Soc. for 1893, p. 582, pl. viii, fig. 6.
— — *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 75, pl. xiii, figs. 728—730.

Characters.—Test long and slender, broadest near the middle; ends drawn out to fine apertural points.

Occurrence.—Very common in the existing seas in almost every latitude, ranging from estuarine shallows to the mid-ocean bed at 2300 fathoms. Fossil specimens have been recorded from the Jurassic of Switzerland (Haeusler); the Cretaceous (?) of Sicily (Ehrenberg); the Gault of Folkestone; the Miocene of Messina; the Pliocene of Sicily, Italy, and St. Erth. In the Coralline Crag it has been met with at Sutton only.

6. LAGENA STRIATA (*d'Orbigny*), 1839. Plate I, figs. 38 and 39; Plate VII, fig. 8.

Part I, 1866, p. 35; and Appendix II, Table, No. 27.

Additional Synonyms:

OVULINA STRIATA, *Seguenza*, 1862. Foram. Monotal. Mess., p. 40, pl. i, figs. 6, 7.
PHIALINA HAIDINGERI, TENUISTRIATA, GEMMELLARII, CYLINDRACEA, *Idem*, 1862. Ibid., figs. 20, 21, 23, 24.
LAGENA STRIATA, *Jones, Parker, and Brady*, 1866. Monogr. For. Crag., p. 35, pl. i, figs. 38—40.
— TENUISTRIATA, *Stache*, 1865. Novara-Reise, Geol. Th., vol. i, p. 184, pl. xxii, fig. 4.
— Nos. 46—50, *Schlicht*, 1870. Pierzpuhl, p. 9, pl. iii, figs. 1—5, 7—11.
— VULGARIS, var. STRIATA, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 52, pl. xix, figs. 16, 20.
— — var. STRIATO-AREOLATA, *Idem*, 1872. Ibid., p. 53, pl. xix, fig. 21.

LAGENULINA, *Terquem*, 1876. Anim. Plage Dunkerque, fasc. 2, p. 68, pl. vii, fig. 7.
LAGENA STRIATA, *Brady and Robertson*, 1876. Rep. Brit. Assoc. for 1875, p. 189.
— GRINZINGENSIS, *Karrer*, 1877. Geol. k. F.-J. Wasserleitung, p. 378, pl. xvi, *b*, fig. 17.
— STRIATA, *Terrigi*, 1880. Atti Acc. P.N. Lincei, vol. xxxiii, p. 177, pl. i, fig. 5.
— — *Möbius*, 1880. Meeresf. Mauritius, &c., p. 89, pl. viii, fig. 3.
— — *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 7.
— — *Green*, 1881. Amer. Journ. Microsc., vol. vi, p. 46, pl. o, fig. 5.
— — *Jones*, 1883. Microgr. Dict., ed. 4, p. 452, pl. xxiii, fig. 24.
— — *Brady*, 1884. Report 'Challenger,' pp. 444 and 460, pl. lvii, figs. 22, 24, 28, 29.
— — *Haeusler*, 1887. Neues Jahrb. for 1887, part 1, p. 184, pl. v, fig. 6.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222, pl. xliv, fig. 28.
— — *Fornasini*, 1893. Mem. Roy. Accad. Sci. Istit. Bologna, ser. 5, vol. iii, p. 431, pl. ii, fig. 2 (= *Phialina cylindracea*, Seguenza).
— — *Egger*, 1893. Abhandl. k. Bayer. Ak., vol. xviii, part 2, p. 327, pl. x, figs. 21—24, 31.
— — *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 75, pl. xiii, figs. 732—736.[1]

Characters.—Typically flask-shaped; oval body with tubular neck; marked with delicate, parallel, longitudinal striæ, like delicately engraved lines, but it is often variable in shape of the body, length of neck, and nature of the striæ. In our figured specimen the striæ have a spiral arrangement, but they retain a straighter and more vertical position than those characterising Egger's *L. tortilis* ('Abhandl. K. Bayer. Akad. Wiss.,' vol. xviii, part 2, 1893, p. 329, pl. x, figs. 61—63).

L. lineata, Williamson, appears to be the most delicately striate of the *Lagenæ*; and a relative coarseness of this ornament of incised lines increases among the "*striata*" group, until the striæ or thin lines may be said to broaden into furrows or *sulci*. In this aspect the intervals of the striæ may be said to become ridges. These latter, however, may not in all cases be truly homologous with the intervals between the striæ; for on these narrow spaces there often appear to be independent exogenous growths of linear shell-matter, which takes the form of interrupted ridges, granules, linear or diffused, and prickles, coarse or fine, and more or less irregularly scattered.

Occurrence.—*Lagena striata* has a very wide geographical range. It is more common in the shallow waters of arctic and antarctic seas. In the temperate and

[1] In the former list of synonyms at p. 35 *Oolina* (*Ovulina*) *sicula*, Ehrenb., is *Lagena sulcata*; and *Lagena vulgaris*, var. *gracilis*, Williamson, is *Lagena gracilis*.

tropical oceans it is found generally at great depths, 1070 to 2740 fathoms; but specimens were obtained by the 'Challenger' in the North Pacific at depths of 40 and 345 fathoms.

As a fossil it is recorded from the Eocene London Clay; the Oligocene of Germany; the Miocene of Italy, Vienna, and Malta; and the Pliocene of Belgium (Scaldisian), Piedmont, and St. Erth. In the Coralline Crag we have it from Broom Hill, zones **d** and **e**, Gedgrave and Sutton, zone **f**.

7. LAGENA SULCATA (*Walker and Jacob*), 1798. Plate I, figs. 40, 41.

Part I, 1886, page 36; and Appendix II, Table, No. 28.

Additional Synonyms:

Orthocerata perfecté globularia, *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. 43 *H*.
Polymorpha, Sphærulæ siphunculatæ, *Soldani*, 1791. Testaceograph., vol. i, part 2, p. 116, pl. cxix, fig. *R*; p. 118, pl. cxxix, fig. *cc*.
OOLINA SICULA, *Ehrenberg*, 1854. Mikrogeol., pl. xxvi, fig. 1.
ENTOSOLENIA COSTATA, *Williamson*, 1858. Rec. For. Gt. Brit., p. 9, pl. i, fig. 18.
OVULINA SULCATA, varr. ELONGATA et INFLATA, *Sequenza*, 1862. Foram. Mon. Messin., p. 41, pl. i, figs. 8—10.
PHIALINA LAGENA, EXIGUA, INCERTA, COSTATA, COSTÆ, REUSSIANA, *Idem*, 1862. Ibid., pp. 46—48, figs. 22, 25—29.
AMPHORINA LYELLII et COSTATA, *Idem*, 1862. Ibid., p. 52, figs. 40, 41. (Apiculate.)
LAGENA CÆPULLA, *Schwager*, 1866. Novara-Exp. Geol. Theil, vol. ii, p. 205, pl. iv, figs. 20 *a*, *b*.
— SULCATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 36, pl. i, figs. 40 and 41 (42 and 43 = *acuticosta*, Reuss).
— — *Mackie*, 1867. Science Gossip, vol. iii, p. 129, figs. 107 and 108.
— Nos. 31, 52, *Schlicht*, 1870. Pietzpuhl, pp. 7, 10, pl. ii, fig. 10; pl. iii, figs. 14, 20.
— MUCRONULATA, *Reuss*, 1870. Sitz. k. Akad. Wiss. Wien, vol. lxii, p. 467, No. 8; *Schlicht*, 1870, Foram. Pietzpuhl, pl. iii, figs. 18 and 24 (apiculate).
— VULGARIS, var. SULCATA, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 55, pl. xix, figs. 25, 26.
— — var. BICAMERATA, *Idem*, 1872. Ibid., p. 65, pl. xix, fig. 62.
— LATICOSTA, *Terquem et Berth.*, 1875. Mém. Soc. Géol. France, ser. 2, vol. x, Mém. iii, p. 15, pl. i (xi), fig. 11.

LAGENA SULCATA, *Brady and Robertson*, 1876. Rep. Br. Assoc. for 1875, p. 189.
LAGENULINA COSTATA, *Terquem*, 1876. Plage Dunkerque, p. 67, pl. vii, fig. 2.
LAGENA NATRII, *Blake*, 1876. Yorkshire Lias, p. 453, pl. xviii, fig. 8 (= *? striata*).
— SULCATA, *Wright*, 1877. Proceed. Belfast Field Club for 1876–7, Appendix iv, p. 103, pl. iv, fig. 10.
CAPITELLINA MULTISTRIATA, *Marsson*, 1878. Mitth. Nat. Verein Neu-Vorpom. u. Rügen, Jahrg. x, p. 123, pl. i, fig. 3.
LAGENA SULCATA, *Vine*, 1878. Science Gossip, vol. xiv, p. 52, fig. 27.
— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 114, fig. 18*f*.
— COSTATA,[1] *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, mém. iii, p. 27, pl. i (ix), fig. 11 (*L. sulcata ?* neckless).
— ORNATA, *Terquem*, 1882. Ibid., fig. 12.
LAGENA SULCATA, *Brady*, 1884. Report 'Challenger,' pp. 445 and 462, pl. lvii, figs. 23, 26, 33, 34; pl. lviii, figs. 4, 17, 18; and "winged varieties," p. 462, pl. lxi, figs. 35—37.
— — *Balkwill and Wright*, 1885. Trans. R. I. Acad., vol. xxviii (Sci.), p. 338, pl. xiv, figs. 1 and 2.
— STRIATA, *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 745, pl. xiv, fig. 16 (long-necked).
— — var., *Iidem*, 1886. Ibid., fig. 17 (round, with sharp ribs; approaching *acuticosta*).
— SULCATA, *Iidem*, 1886. Ibid., fig. 18.
— — *Brady*, 1887. Ibid., vol. for 1887, p. 903.
— COSTATA, *Idem*, 1887. Ibid., p. 184, pl. v, fig. 5 (neckless; strong ribs).
— STRIATA, *Idem*, 1887. Ibid., fig. 6 (neckless; feeble riblets).
— — *Brady*, 1888. Geol. Mag., dec. 3, vol. v, p. 481, pl. xiii, fig. 11.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, fig. 11. No. 7, p. 222, pl. xliv, figs. 18, 22, 34.
— — *Chapman*, 1893. Journ. Roy. Micr. Soc. for 1893, p. 583, pl. viii, fig. 11.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 78, pl. xiii, figs. 742—744.

Characters.—To the description given at p. 36 of Part I we may add that the riblets not only vary in strength, but in length, sometimes reaching halfway or less from the base to the top (that is, from the aboral to the oral end of the shell), becoming *semistriata*, sometimes alternating, long, and short, as in *interrupta*. Also that the upper end of the striæ may become spiral on the neck, as in *striata;* and the lower ends may either end off distinct around the base, or may be fused together into a mucro.

Occurrence.—*Lagena sulcata* is at home in all seas and at nearly all depths, and

[1] It is not possible to determine, in many cases, if the published "costate" and "sulcate" forms have been named strictly in accordance with the plan of their sculpturing.

is one of the most abundant of the *Lagenæ*. Its geological range is likewise very extensive. It has been found in the Upper Silurian of Woolhope (Brady); in the Lower Lias of Yorkshire (Blake); in the Gault of Folkestone (Chapman); in the Upper Chalk of Swanscombe and Taplow (Chapman), and of Keady Hill (Wright); in the Eocene of London Clay; in the Oligocene of Elsass; in the Miocene of Malaga, and of Muddy Creek, Victoria; in the Pliocene of Garrucha (South Spain), Piedmont, Kar-Nicobar, and St. Erth; and in Pleistocene deposits generally. In the Coralline Crag it is rare, but specimens have been found at nearly every zone examined. It has also been found in the Red Crag. It is to be noted that, while *L. sulcata* is rare in the Crag, the closely allied form *L. acuticosta* is very common.

8. Lagena acuticosta, *Reuss*, 1862. Plate I, figs. 42, 43 ("*L. sulcata*," Part I, p. 36).

Lagena acuticosta, *Reuss*, 1862. Sitz. k. Ak. Wiss. Wien, vol. xliv, p. 305, pl. i, fig. 4.
— — *Idem*, 1863. Ibid., vol. xlvi, p. 331, pl. v, fig. 63.
— sulcata (part), *P. and J.*, 1865. Phil. Trans., vol. clv, p. 351, pl. xiii, figs. 30 *a*, *b*, 31 *a*, *b*.
— — (—), *J.*, *P.*, *and B.*, 1866. Monogr. For. Crag, p. 36, pl. i, figs. 42, 43 (not 41).
— acuticosta, *Reuss*, 1870. Sitz. k. Akad. Wien., vol. lxii, p. 467, No. 10.
— No. 55, *Schlicht*, 1870. Pietzpuhl, p. 10, pl. iii, figs. 17 and 23.
— acuticosta, *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 9.
— — *Brady*, 1884. Report 'Challenger,' pp. 445 and 464, pl. lvii, figs. 31 and 32; pl. lviii, figs. 20 (?), 21.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222, pl. xliv, figs. 26 *a*, *b*, 31.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, pp. 321 and 329, pl. x, figs. 47, 48, 80—84.
— — *Chapman*, 1893. Journ. R. Micr. Soc. for 1893, p. 583, vol. viii, figs. 12 *a*, *b*.
— — *Idem*, 1894. Quart. Journ. Geol. Soc., vol. l, p. 706.

Figs. 42 and 43 were included in *L. sulcata* at page 36 of Part I (1866), and as a "strong form" in the explanation of Pl. I. This is an extreme example of the ridge-growth, and has been separated off by Reuss as having relatively few and large costæ, which he describes as being sometimes (from Pietzpuhl) high and thin. Two good specimens were figured in the 'Phil. Trans.,' 1865, pl. xiii, figs. 30 and 31; and were referred to at page 351 as the best characterised among the group "*sulcata*" by their large size, boldness of growth, strength of the

ribs (twelve to fourteen), and their radiate aperture. They evidently stand with *L. acuticosta* as above described.

Occurrence.—*Lagena acuticosta* was found by the 'Challenger' at four stations: in the North Pacific, at a depth of 2300 fathoms; in the Equatorial Pacific, depth 2425 fathoms; in the South Pacific, depth 2350 fathoms; and in the Southern Ocean off Heard Island at a depth of 75 fathoms. It is interesting to notice that the bottom temperature at each of the three Pacific stations was 1° Centigrade.

Its geological history extends to the Cretaceous period. It has been recorded from the Neocomian (Bargate Beds) of Surrey; from the Gault of Folkestone; from the Upper Chalk of Maestricht; and from the Oligocene of Pietzpuhl. We have specimens also from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it is the commonest of the *Lagenæ*, and the specimens are generally large and well grown.

9. Lagena gracilis, *Williamson*, 1848. Plate VII, figs. 6 *a*, *b*.

Lagena gracilis, *Williamson*, 1848. A. M. N. Hist., ser. 2, vol. i, p. 13, pl. i, fig. 5.
— vulgaris, var. gracilis, *Williamson*, 1858. Rec. Foram. Great Brit., p. 7, pl. i, figs. 12, 13.
— gracilis, *Reuss*, 1863. Sitz. k. Akad. Wiss. Wien, vol. xlvi, part 1, p. 331, pl. iv, figs. 58—61; pl. v, fig. 62.
— — *Schwager*, 1866. Nov.-Exp. Geol., vol. ii, p. 206, pl. iv, figs. 21 *a*, *b*.
— Nos. 40—43, *Schlicht*, 1870. Pietzpuhl, p. 8, pl. ii, figs. 19, 20, 24, 25.
— vulgaris, var. caudata, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 54, pl. xix, fig. 22.
— gracilis, *Siddall*, 1879. Catal. Brit. Rec. For., p. 5.
— — *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 6.
— — *Brady*, 1884. Report 'Challenger,' pp. 445 and 464, pl. lviii, figs. 2, 3, 7, 10, 19, 22—24.
— — *Chapman*, 1893. J. R. Microsc. Soc., p. 563, pl. viii, fig. 13.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad., vol. xviii, part 2, pp. 321, 328, pl. x, figs. 25, 33, 49.
— — *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 77, pl. xiii, fig. 738.

Characters.—Long, flask-shaped, phialine, or fusiform; with long or short neck, tapering or apiculate below; bearing longitudinal costulæ, fine or coarse. Figs. 6 *a* and 6 *b* show an individual hexagonal in section, with six rather thick riblets.

Occurrence.—*Lagena gracilis* has a wide geographical distribution. It is not uncommon in shallow waters on the western shores of Europe, but the

'Challenger' specimens were obtained for the most part from the deep seas of the Southern Hemisphere, the greatest depth being 2775 fathoms. The fossil distribution extends from the Gault of Folkestone through nearly all formations to the present time. It has been found in the Upper Chalk of Swanscombe and Keady Hill (Ireland); in the London Clay; in the Oligocene of Elsass and Pietzpuhl, the Pliocene of Calabria and Kar-Nicobar, and the Post-pliocene of the north-east of Ireland. In the Coralline Crag we have found only one small specimen at Tattingstone, zone **d**.

10. LAGENA SEMISTRIATA, *Williamson*, 1848. Plate IV, fig. 6.

Part I (1866), page 34, No. 3; and Appendix II, Table, No. 26.

Additional Synonyms :

OOLINA STRIATICOLLIS, *Reuss*, 1862. Sitz. Akad. Wien., vol. xlvi, p. 327, pl. iii, fig. 40.
LAGENA SULCATA (pars), *Parker and Jones*, 1865. Phil. Trans., vol. clv, pp. 348 and 350, pl. xvi, fig. 6.
— SEMISTRIATA, *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 34, pl. iv, fig. 6.
— — *Mackie*, 1867. Science Gossip, vol. iii, p. 130, fig. 111.
— Nos. 32, 44, 45, *Schlicht*, 1870. Pietzpuhl, pp. 7, 9, pl. ii, figs. 12, 17, 18.
— VULGARIS, var. SEMISTRIATA, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 52, pl. xix, fig. 15.
— — — *Hantken*, 1875. Mitth. Jahrb. Ung. g. Anst., vol. iv, p. 22, pl. xii, fig. 6.
— SEMISTRIATA, *Zittel*, 1876. Handb. Palæont., part 1, p. 85, fig. 21 I.
— — *Brady and Robertson*, 1876. Rep. B. Assoc. for 1875, p. 189.
LAGENULINA SEMISTRIATA, *Terquem*, 1876. Plage Dunkerque, p. 68, pl. vii, fig. 8.
LAGENA SEMISTRIATA, *Green*, 1881. Amer. J. Microsc., vol. vi, p. 46, fig. 2.
— TENUIS, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 26, pl. i (ix), fig. 8.
— PERLUCIDA, *Schlumberger*, 1882. Feuille J. Nat., ann. xii, pl. i, fig. 2.
— SEMISTRIATA, *Jones*, 1883. Microgr. Dict., edit. 4, p. 452, pl. xxiii, fig. 25.
— — *Brady*, 1884. Report 'Challenger,' pp. 445 and 465, pl. lvii, figs. 14, 16, 17.
— — *Quenstedt*, 1885. Handb. Petref., ed. 3, part 5, p. 1049, pl. lxxxvi, fig. 2.
— — *Wright*, 1886. Proc. Belfast F. Club, Appendix ix, p. 324, pl. xxvi, fig. 6.
— SULCATA, *Haeusler*, 1887. Neues Jahrb. for 1887, part 1, pp. 183 and 189, pl. v, figs. 1—4 (short and imperfect ribs); and figs. 38 and 39 (bilocular, "or *Nodosaria raphanus*").

Lagena semistriata, *Steinmann*, 1888. Elem. Paläont., vol. i, p. 27, fig. 8 a.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 321, 327, pl. x, figs. 34, 39.
— semistriata, *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 76, pl. xiii, fig. 737.

Characters.—This intermediate form is characterised by variable riblets, generally strong and wide-apart, reaching upwards from the base towards the middle of the shell. There are no sunken striæ.

Dr. G. C. Wallich figured a semistriate entosolenian *Lagena* in "The North Atlantic Sea-bed," 1862, pl. v, fig. 17, without description. An interesting example of a double growth of *L. semistriata* is shown by fig. 22, pl. vii, of Bütschli's descriptive part of Bronn's 'Klassen, &c., Thier-Reichs,' 1880.

Occurrence.—*Lagena semistriata* has a wide range in recent seas. It has been recorded from Hunde Islands, Davis Strait, at a depth of 25—70 fathoms; from Novaya Zemlya, 10—219 fathoms; Kerguelen Island, 29—120 fathoms; and West Coast of Patagonia, 40—175 fathoms. In the North Pacific it has been found at depths of from 2300 to 3125 fathoms; in the South Pacific at depths of from 2325 to 2350. Off the Azores it has been found at a depth of 1000 fathoms; off the North-west Coast of Ireland at a depth of 1443 fathoms. It is interesting to notice, from the details given in the 'Challenger' Report, that the bottom temperature where the deep-water specimens were obtained was 1° Cent. It would thus appear that *L. semistriata* is a cold-water form.

Records of the occurrence of *L. semistriata* in a fossil condition are rare. It has been found in the Oligocene of Hermsdorf, the Miocene of Bavaria and Messina, the Pliocene of Antwerp (Reuss) and St. Erth; and we have well-developed specimens in our own Collection from the Pleistocene of Gourock, near Greenock. In the Coralline Crag, in addition to the occurrence at Sutton previously recorded, we have found it at Gedgrave, zone **f**.

11. Lagena melo (*d'Orbigny*), 1847. Plate I, fig. 35.

Part I, 1866, p. 38, No. 6; and Appendix II, Table, No. 29.

Additional Synonyms:

Polymorpha. Sphærulæ siphunculatæ, *Soldani*, 1791. Testac., &c., vol. i, part 2, p. 116, pl. cxx, fig. *b b* (?).
Entosolenia squamosa, var., *J. W. Dawson*, 1859. Canad. Nat., vol. iv, p. 29, fig. 10.
Lagena melo, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 38, pl. i, fig. 35.
— — *Mackie*, 1867. Science Gossip, vol. iii, p. 129, fig. 109.

Entosolenia melo, *G. M. Dawson*, 1870. Canad. Nat., N.S., vol. 5, p. 178.
Lagena[1] (bilocular), *Parker, Jones, and Brady* (*Soldani*[2]), 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 157, pl. ix, fig. 33 (= *Nodosaria cancellata*, d'Orb., 1826, Ann. Sci. Nat., vol. vii, p. 254, No. 29).
— melo, *Brady and Robertson*, 1876. Brit. Assoc. Rep. for 1875, p. 190.
— — *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, and explanation of plate, pl. vii, fig. 11.
— — *Brady*, 1884. Report 'Challenger,' p. 446.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222, pl. xliv, figs. 21, 24, 25.

Fig. 19. Fig. 20. Fig. 21.

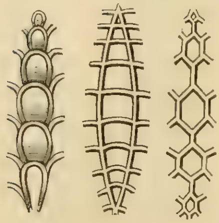

Fig. 19.—Diagram of the ornamentation of *Lagena squamosa* (Montagu).

Fig. 20.—Diagram of the ornamentation of *Lagena melo* (d'Orb.).

Fig. 21.—Diagram of the ornamentation of *Lagena hexagona*, Williamson.

Characters.—For varietal forms of this reticulate *Lagena* with subquadrangular meshes we may point to figs. 21 and 24, pl. xliv, 'Trans. Zool. Soc.,' 1888, both as to its shape and the somewhat variable character of the transverse bars, which in *L. catenulata*, Williamson, become as straight and thick as the longitudinal ridges; also to fig. 25, in which the cross-bars have been formed only on the upper moiety of the shell (*L. sulcata*), just as similar but oblique bars occur on the upper part of fig. 34, pl. xiii, 'Phil. Trans.,' 1865. In figs. 35 and 36 of the same plate these interstitial bars have an upward curvature, characterising *Nodosaria cancellata*, d'Orbigny (see above). The curve, however, of some only of the bars in *L. melo* is a very different condition from that in *L. squamosa;* for in the latter each areole represents, as it were, a loop bent in between the verticals (see diagram, fig. 19), whilst in *L. melo* (diagram, fig. 20) each cross-bar, whether quite straight or somewhat bent, passes direct from one vertical to the other.

The *Lagena* described and figured by Terrigi, 'Mem. R. Accad. Lincei,' ser. 4, vol. vi, 1889, p. 112, pl. vi, fig. 1, with doubt as *L. melo,* evidently has some alliance with Brady's *L. favoso-punctata.*

Occurrence.—*Lagena melo* has been found in the living condition in British seas (Williamson, Brady), in the North Atlantic and Arctic waters (Parker and Jones), in the Mediterranean (Jones and Parker), and originally on the South

[1] This is figured also in 'Phil. Trans.,' 1865, pl. xiii, fig. 36, and, together with fig. 35, would come under *L. squamosa*, as defined by Brady, if the arched tops of the areolæ were really distinctive, but they are not.

[2] 'Testac.,' &c., vol. i, p. 91, pl. xcv, fig. a.

American littoral by d'Orbigny. No specimen was obtained from the 'Challenger' dredgings. We note its occurrence as a fossil from the Eocene of the London Clay, the Miocene of Messina (Seguenza) and Muddy Creek, Victoria, and from the Pliocene of St. Erth. We have specimens also in our own collection from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have specimens from every locality examined except Aldborough.

12. Lagena hexagona (*Williamson*), 1848. Plate VI, fig. 7.

Entosolenia squamosa, var. hexagona, *Williamson*, 1848. A. M. N. H., ser. 2, vol. i, p. 20, pl. ii, fig. 23.
— — — — *Idem*, 1858. Rec. Foram. Gt. Brit., p. 13, pl. i, fig. 32.
— — — scalariformis, *Idem.*, 1858. Ibid., fig. 30 (very large areolæ).
Lagena squamosa, *Parker and Jones*, 1862. Introd. Foram., Appendix, p. 309.
— scalariformis (part), *Reuss*, 1862. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 333, pl. v, fig. 69 (very large areolæ).
— favosa, *Idem*, 1862. Ibid., p. 334, pl. v, figs. 72, 73 (large, and very large areolæ).
— geometrica, *Idem*, 1862. Ibid., fig. 74 (small areolæ).
Ovulina ornata, *Seguenza*, 1862. Foram. Monotal. Messin., p. 42, pl. i, fig. 12 (large areolæ).
Phialina ornata, *Idem*, 1862. Ibid., p. 48, fig. 30 (small areolæ).
Lagena sulcata, var. (Entosolenia) squamosa, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 354, pl. xvi, figs. 11 *a*, *b*.
— geometrica, *Hantken*, 1875. Mitth. Jahrb. Ung. g. Anst., vol. iv, p. 22, pl. xii, fig. 8.
— Mariæ, *Karrer*, 1877. Geol. F.-J. Wasserl., p. 378, pl. xvi *b*, fig. 16.
— hexagona, *Siddall*, 1879. Catal. Brit. Rec. Foram., p. 6.
— squamosa, var. hexagona, *B. and R.*, 1876. R. B. Assoc. for 1875, p. 190.
— hexagona, *Green*, 1881. Amer. Journ. Microsc., vol. vi, p. 46, fig. 41.
— — *Brady*, 1884. Report 'Challenger,' pp. 446 and 472, pl. lviii, figs. 32, 33.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 326, pl. x, fig. 60.

Characters.—*Lagenæ*, presenting various modifications of the flask-like shape, which have a surface-reticulation of equally raised meshes, forming large or small hexagons regularly disposed. See the diagram, fig. 21, p. 192.

Occurrence.—*Lagena hexagona* has a wide bathymetrical range. The 'Challenger' specimens were obtained at depths ranging from 40 to 2425 fathoms, but exclusively from stations in temperate and tropical seas. It is worthy of note that no specimen of *L. hexagona* is recorded in the 'Challenger' Report from the dredgings in high latitudes, whereas *L. squamosa* was found commonly in those areas.

The geological history of *L. hexagona,* like that of its congeners *L. melo* and *L. squamosa,* is not known at present to extend beyond the Tertiary period. It has been found in the Oligocene of Elsass, the Miocene of Italy, Vienna, and of Muddy Creek (Victoria), the Pliocene of Garrucha (South Spain), Piedmont, and St. Erth, and in beds of Pleistocene age in Scotland and Ireland. We have ourselves found it in the Scaldisian of Antwerp. In the Coralline Crag it occurs at Broom Hill, zone **d**, Gedgrave, zone **f**, and Sutton, zones **e** and **f**.

13. Lagena seminuda, *Brady,* 1884. Plate VI, figs. 8 *a, b.*

Lagena seminuda, *Brady,* 1884. Report 'Challenger,' pp. 446 and 472, pl. lviii, figs. 34 *a, b.*

Characters.—Test subglobular or somewhat pyriform; orifice in a crater-like depression on the truncate oral extremity; surface ornament consisting of a raised reticulation (hexagonal in Pl. VI, fig. 8, and less regular in Brady's figure), confined to the lower half of the shell; the remainder being smooth.

The striking characteristic of *L. seminuda* is its truncate oral end, and this feature is very constant. Of the many specimens found in the Coralline Crag, not one shows any approach to a produced neck. In its surface ornamentation *L. seminuda* presents the same relation to *L. hexagona* as *L. costata,* Williamson, does to *L. sulcata,* W. and J., and *L. semistriata,* Williamson, to *L. striata,* d'Orbigny. In *L. seminuda, L. costata,* and *L. semistriata* the specific ornamentation is located on the posterior portion of the test, and may partially invest the shell to a greater or less degree anteriorly. It appears to be a characteristic of the *Lagenæ* that where only a portion of the test is furnished with a particular type of ornamentation, that portion includes the aboral extremity.

Occurrence.—*L. seminuda* was described for the first time by Brady in the 'Challenger' Report. On reference to the tables at the end of the Report we find that the 'Challenger' specimens were obtained from the temperate zone at depths ranging from 1375 to 2350 fathoms. The bottom temperatures varied from 0·4° C. to 1·5° C. In the body of the Report, Brady states that it has been found in shallower waters in the North Atlantic.

L. seminuda has lately been recorded by Mr. Millett from the Pliocene of St. Erth, where it is stated to be rare. We have also found a single specimen in the Scaldisian of Antwerp. In the Coralline Crag we have found it rather commonly at Sutton, zone **f**, and less frequently at Broom Hill, zone **d**, Gedgrave, zone **f**, and Aldborough, zone **g**.

14. Lagena reticulata (*Macgillivray*), 1843. Plate IV, fig. 7 ("*L. squamosa*").

Part I, 1866, page 39, No. 7 ("*L. squamosa*"); and Appendix II, Table, No. 30.

Corrected Synonymy:

Orbulina aterrima, *Costa*, 1838. Faun. Regn. Nap., p. 4, pl. iii, fig. 7.
Lagenula reticulata, *Macgillivray*, 1843. Moll. Anim. Aberdeen, &c., p. 38.
Entosolenia squamosa, *Williamson*, 1848. Ann. Mag. Nat. Hist., ser. 2, vol. i, p. 18, pl. ii, fig. 19.
— typica, *Idem*, 1858. Rec. Foram. Gt. Brit., p. 12, pl. i, fig. 29.
— reticulata, *Reuss*, 1862. Sitz. k. Akad. Wiss. Wien, vol. xliv, p. 333, pl. v, figs. 67, 68.
— — *Idem*, 1863. Bull. Acad. Roy. Belg., ser. 2, vol. xv, p. 144, pl. i, fig. 16.
— anomala, *Stache*, 1865. Novara-Exped. Geol. Thiel., vol. i, part 2, p. 183, pl. xxii, fig. 5.
Lagena sulcata, var. squamosa, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 354, pl. xiii, figs. 40, 41.
— squamosa, *J., P., and B.*, 1866. Mon. For. Crag, p. 39, pl. iv, fig. 7.
Entosolenia squamosa, *Dawson*, 1866. Handb. Zool., p. 44, fig. 33 (1st fig.).
Lagena reticulata, *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, pl. vii, fig. 10.
— — *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, p. 28, pl. i (ix), fig. 15.
— hexagona ?, var., *Balkwill and Millett*, 1884. Journal of Microscopy, &c., vol. iii, pp. 79 and 89, pl. i, fig. 10.
— — *Goës*, 1894. K. Svensk. V. Handl., vol. xxv, No. 9, p. 80, pl. xiii, fig. 746.

Characters.—Fig. 7, Pl. IV, described as *L. squamosa* (from Bridlington) at page 39 of Part I, represents one of the *Lagenæ* which have a delicate superficial network of irregularly shaped meshes, without any orderly arrangement; and doubtless, except for its more delicate reticulation, quite corresponds with *L. reticulata* (Macgillivray), adopted by Reuss, but needlessly grouped with *squamosa* by Brady.

Occurrence.—*L. reticulata* exists in the Arctic Ocean and in the British seas. In the fossil state it occurs in the Eocene Tertiary of the Paris Basin, in the Diestian of Antwerp, and in a Tertiary Marl of New Zealand. The figured specimen was from Bridlington, and, though not from the Pliocene Crag, we describe it here both in correction of a former error, and on account of its close relation to *L. hexagona* and its allies.

14*. *Note on* LAGENA SQUAMOSA (*Montagu*), 1803. Diagram, woodcut, fig. 19.

At page 39 of Part I, 1866, *Lagena reticulata* was mistaken as typical of *L. squamosa;* and one specimen of the latter species had been obtained from the Pleistocene bed at Bridlington, then regarded as "Crag" of Pliocene age (page 40). Although not coming within our present list of the Foraminifera of the Crag, it is of sufficient interest for us to offer here some remarks on *L. squamosa.*

In the 'Philos. Transact.,' 1865, p. 354, Parker and Jones referred the name "*squamosa*" to such *Lagenæ* as have both four- and six-sided areolæ formed of the longitudinal and cross ridges; and for illustration gave figs. 40 and 41 in pl. xiii, and figs. 11 *a*, *b*, in pl. xvi; the first set having delicate hexagons, diffused over the surface without any definite order (*L. reticulata*); and the latter having the meshes in a vertical succession (*L. hexagona*). In his Report of the 'Challenger,' p. 471, H. B. Brady has shown that *L. squamosa* (Montagu) has a vertical and parallel arrangement of subquadrangular areolæ, arched (convex) on their upper borders, and corresponding with Montagu's obscure sketch. Brady's figs. 28 and 29 still more closely match Wallich's fig. 21, pl. v, in 'The North Atlantic Sea-bed,' 1862.

Characters.—In *L. squamosa* the interstitials do not coalesce with or pass into the verticals at right angles, but have their ends curved down against the latter, so as to appear to pass below the curve next below. See the diagram, fig. 19, page 192.

A near ally to *L. squamosa* is evidently Seguenza's *Orbulina foveolata*, 'Mioc. Monot. Messin.,' 1862, p. 37, pl. i, figs. 1, 2. This is represented as globose, with a radiate aperture in its flattened apex, and ornamented with nearly vertical rows of subpolygonal little pits, which have a squamose appearance on the sides, and are represented in the end view as having raised interstices.

Occurrences.—*Lagena squamosa* is most commonly found in the shallow waters of high latitudes; but specimens were obtained by the 'Challenger' from comparatively shallow waters (390 to 410 fathoms) off the Danish West Indies, and off Sydney, New South Wales. Specimens were also found at one station in the North Pacific (2300 fathoms), and at another in the South Atlantic (1990 fathoms).

The geological range of *L. squamosa* has not hitherto been found to extend beyond the Tertiary deposits. It has been met with in the Eocene (Calcaire grossier) of the Paris Basin, in the Miocene of Messina, and in the Pliocene of Belgium and St. Erth. The specimen recorded as *L. squamosa* in the First Part of the Monograph is *L. reticulata*, of Pleistocene age, from Bridlington.

15. Lagena lævigata (*Reuss*), 1849. Plate VII, fig. 14.

Fissurina lævigata, *Reuss*, 1849. Denks. k. Akad. Wiss. Wien, vol. i, p. 366, pl. xlvi, figs. 1 *a*, *b*.
— globosa, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 317, pl. xii, fig. 4.
— simplex (?), *Seguenza*, 1862. For. Monot. Mess., p. 56, pl. i, fig. 44.
— deltoidea, *Idem*, 1862. Ibid., p. 57, pl. i, fig. 45.
— latistoma, *Idem*, 1862. Ibid., figs. 46, 47.
— Biancæ, *Idem*, 1862. Ibid., figs. 48—50.
— acuta, *Idem*, 1862. Ibid., fig. 51.
Lagena vulgaris, var. fissurina, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 51, pl. xix, figs. 6—8.
— lævigata, *Terrigi*, 1880. Atti Accad. Pont. Nuovi Lincei, vol. xxxiii, p. 177, pl. i, fig. 6.
— — *Robertson*, 1883. Trans. Geol. Soc. Glasgow, vol. vii, p. 24.
— — *Brady*. Rep. 'Chall.,' pp. 446 and 473, pl. cxiv, figs. 8 *a*, *b*.
— — *Balkwill and Millett*, 1884. Journal Microscopy, vol. iii, pp. 80, 81, pl. ii, fig. 6; pl. iii, fig. 6.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222.
— lucida, *Fornasini*, 1888. B. S. Geol. Ital., vol. viii, p. 47, pl. iii, figs. 5, 5 *a*.

Characters.—Pyriform, compressed, the two faces rather convex, the transverse section suboval, aperture entosolenian and narrow, with a short external neck.

Occurrence.—*Lagena lævigata* is one of the most common and widely distributed of recent *Lagenæ*. It was found by the 'Challenger' at depths ranging from 2 to 3125 fathoms. It is likewise very common as a fossil, chiefly from Tertiary deposits. It has been recorded from the Chalk of Rügen (Marsson); from the Calcaire Grossier of the Paris Basin; from the Oligocene of Elsass and Pietzpuhl; from the Miocene of Messina and Vienna; from the Pliocene of Messina and St. Erth; and from the Pleistocene of Scotland. We have found it also in the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have noticed its occurrence only at Tattingstone and Broom Hill, both in zone **d.**

16. Lagena quadrata (*Williamson*), 1858. Plate VII, fig. 9.

Entosolenia marginata, var. quadrata, *Williamson*, 1858. Rec. Foram. Gt Britain, p. 11, pl. i, figs. 27, 28.
Fissurina Pecchiolii, *Seguenza*, 1862. For. Mon. Messin., p. 58, pl. i, fig. 52.
— recta, *Idem*, 1862. Ibid., fig. 53.
— oblonga, *Idem*, 1862. Ibid., p. 68, pl. ii, fig. 35.
— lucidia, var. quadrata, *Reuss*, 1863. Sitz. Ak. Wien, vol. xlvi, p. 324, pl. iii, fig. 26.
Entosolenia quadrata, *Chimmo*, 1870. Bed of Atlantic, p. 28, pl. x, fig. 2.
— — *Möbius*, 1880. Meeresf. Mauritius, p. 90, pl. viii, fig. 9.
Lagena quadrata, *Brady*, 1884. Report 'Challenger,' pp. 446 and 475, pl. lix, figs. 3 and 16; pl. lx, fig. 5.
— — *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 81, pl. ii, fig. 8.
— lævigata, var. quadrata, *Wright*, 1886. Proc. Belfast N. Club, p. 324, pl. xxiv, fig. 9.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 331, pl. x, figs. 78, 79.
— compressa, *Egger*, 1893. Ibid., figs. 1, 2.

Characters.—This compressed, subquadrate Lagena is near to *lævigata*. Although very variable, it always has a tendency to assume the form of a parallelogram, with more or less rounded extremities; and sometimes a considerable exogenous growth thickens the edges with a keel, either blunt, sharp, or imperfect.

Lagena Seguenziana, Fornasini, 'Boll. Soc. Geol. Ital.,' vol. v, 1886, pp. 350—353, pl. viii, figs. 1—8, belonging to the group of *L. lævigata* and *L. quadrata*, is an interesting species, of which six varieties are figured (as above quoted). It is characterised as being compressed, subdiscoidal, with a thick edge or margin and strong projecting neck.

Occurrence.—*Lagena quadrata* is stated in the 'Challenger' Report to be confined apparently to comparatively shallow waters,—depths not exceeding 150 fathoms. No mention of the species occurs, however, in the Tables of Distribution given at the end of the Report. It has been recorded by Balkwill and Millett among the Foraminifera of Galway. As a fossil it occurs in the Miocene of Messina, the Pliocene of Messina and St. Erth, and the Pleistocene of North-east Ireland. We have specimens also from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it occurs (but rarely) in nearly every zone examined.

17. Lagena marginata, *Walker and Jacob*, 1784. Plate I, figs. 33, 34; Woodcut fig. 22.

Part 1, 1866, page 41; and Appendix II, Table, No. 31.

Additional Synonyms:

Lagena marginata, *Brown*, 1827. Illustr. Conch. Gt. Brit., fly-leaf, vol. i, pl. i, figs. 30, 31; and 2nd edit., 1844, p. 3, pl. lvi, figs. 30, 31.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 41, pl. i, figs. 33, 34.

Fissurina alata, *Reuss*, 1870. Sitz. k. Akad. Wiss. Wien, vol. lxii, p. 469, No. 2.

— No. 71, 72, 78, *Schlicht*, 1870. Foram. Pietzpuhl., pp. 13, 14, pl. iv, figs. 7—9, 13—15; pl. v, figs. 19—21.

Lagena vulgaris, var. petasma-marginata, *O. Jones*, 1872. Trans. Linn. Soc., vol. xxx, p. 58, pl. xix, figs. 38, 39.

— — var. bracteato-marginata, *Idem*, 1872. Ibid., p. 59, pl. xix, figs. 40, 41.

— — var. alato-marginata, *Idem*, 1872. Ibid., p. 60, pl. xix, fig. 44.

— — var. clavato-marginata, *Idem*, 1872. Ibid., fig. 45.

— — var. pertuso-marginata, *Idem*, 1872. Ibid., p. 61, pl. xix, figs. 46, 67.

— marginata, *Brady and Robertson*, 1876. R. Brit. Assoc. for 1875, p. 189.

Entosolenia marginata, *Möbius*, 1880. Meeresf. Mauritius, p. 90, pl. viii, figs. 7, 8.

Lagena (Entosolenia) marginata, *Bütschli*, 1880. Bronn's Klassen., &c., p. 197, pl. vii, figs. 13, 14, and 22 *a*.

— marginata, *Wright*, 1881. Proc. Belfast F. Club for 1880–81, Appendix, p. 181, pl. viii, figs. 4, 4 *a*.

— — *Green*, 1881. Amer. Journ. Microsc., vol. vi, p. 46, fig. 8.

Fissurina marginata, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 30, pl. i (ix), fig. 22.

Lagena marginata, *Brady*, 1884. Rep. 'Chall.,' pp. 446 and 476, pl. lix, figs. 21—23.

— — *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 81, pl. v, fig. 2, and fig. 8 (variety).

— — *Haeusler*, 1887. Neues Jahrb. for 1887, part 1, p. 186, pl. iv, figs. 51—53.

— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222, pl. xliv, figs. 27, 29 (trigonal), 30, and 32.

Fissurina alata, *Franzenau*, 1889. Math. Termés zetrajzi Erlesita, vol. vii, p. 68, pl. iii, fig. 4.

Lagena marginata, var. triaculeata, *Fornasini*, 1891. For. Plioc. del Ponticello di Savena, pl. ii, fig. 12.

— — *Chapman*, 1893. Journ. R. Microsc. Soc. for 1893, p. 584, pl. viii, figs. 16 *a*, *b*.

— — var. caterinlosa, *Chapman*, 1895. Proc. Zool. Soc., p. 26, pl. i, fig. 5.

LAGENA MARGINATA, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 321 and 332, pl. x, figs. 20, 66, 67, 96, 97.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 81, pl. xiii, figs. 748—751.

FIG. 22.—*Lagena marginata* (Montagu). (From the 'Phil. Trans.,' vol. clv, pl. xvi, fig. 12 *a*.)

Characters.—Sublenticular, pyriform or oval (occasionally trigonal), more or less compressed; keeled or winged at the edge; aperture entosolenian, narrow; base sometimes spinose.

Occurrence.—*Lagena marginata* is found in all latitudes and at all depths. Its geological range is likewise extensive. It has been recorded from the Gault of Folkestone; the Chalk of the island of Rügen; the Eocene (London Clay, and the Calcaire Grossier); the Oligocene of Germany (Pietzpuhl); the Miocene of Malaga, Messina, Vienna, and Muddy Creek (Victoria); the Pliocene of Italy and St. Erth; and from various Pleistocene formations. We have in our own collections specimens from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag *L. marginata* occurs with varying frequency in every zone examined. It has also been recorded from the Red Crag.

18. LAGENA SEMINIFORMIS, *Schwager*, 1866. Plate VII, fig. 10.

MILIOLA STILIGERA? *Ehrenberg*, 1854. Mikrogeol., pl. xxxi, fig. 6.
LAGENA SEMINIFORMIS, *Schwager*, 1866. Novara-Exped. Geol. Theil., vol. ii, p. 208, pl. v, fig. 21.
ENTOSOLENIA MARGINATA? *Chimmo*, 1878. Nat. Hist. Euplectella, p. 21, pl. vi, figs. 20 *a*—*d*.
FISSURINA DIPTERA, *Seguenza*, 1880. R. Accad. Lincei, ser. iii, vol. vi, p. 332, pl. xvii, fig. 36.
LAGENA SEMINIFORMIS, *Brady*, 1884. Report 'Challenger,' pp. 447 and 478, pl. lix, figs. 28—30.

Characters.—Body circular, biconvex; with broad peripheral wing, extended at the base so as to form two points separated by a wide central depression.

Occurrence.—*Lagena seminiformis* was found by the 'Challenger' at several stations, but invariably in very deep water (1000 to 2350 fathoms). As a fossil it has been recorded from the Chalk of Volsk (Ehrenberg), and from the Pliocene of Kar-Nicobar and St. Erth. One specimen only has been found in the Coralline Crag. It comes from Broom Hill, zone **d**.

19. Lagena lagenoides (*Williamson*), 1858. Plate I, figs. 29—31.

Part I, 1866, page 43, No. 9 (*L. ornata*); and Appendix II, Table, No. 32.

Corrected Synonymy:

Entosolenia marginata, var. lagenoides, *Williamson*, 1858. Rec. For. Gt. Brit., p. 11, pl. i, figs. 25, 26.
Lagena lagenoides, *Reuss*, 1862. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 324, pl. ii, figs. 27, 28.
Fissurina trapezoidea, *Seguenza*, 1862. For. Mon. Messin., p. 68, pl. ii, fig. 34.
— Reussiana, *Idem*, 1862. Ibid., p. 69, pl. ii, fig. 40.
— radiata, *Idem*, 1862. Ibid., p. 70, pl. ii, figs. 42, 43.
Lagena ornata, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 43, pl. i, figs. 29—31.
— formosa, *Schwager*, 1866. Nov.-Exped. Geol. II, p. 206, pl. iv, fig. 19 *b*, *c*.
Entosolenia marginata, var. ornata, *G. M. Dawson*, 1870. Canad. Nat., N.S., vol. v, p. 177, pl. o, fig. 12.
Lagena lagenoides, *O. Jones*, 1872. Tr. Linn. Soc., vol. xxx, p. 59, pl. xix, fig. 42.
— vulgaris, var. marginata, *Idem*. 1872. Ibid., p. 55, pl. xix, fig. 32.
— — var. spinosa-marginata, *Idem.*, 1872. Ibid., p. 59, pl. xix, p. 43.
— tubulifera, *Brady*, 1881. Q. J. Micros. Soc., N.S., vol. xxi, p. 61.
— lagenoides, *Idem*, 1884. Report 'Challenger,' pp. 447 and 479, pl. lx, figs. 6, 7, 9, 12—14.
— — *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 82, pl. ii, fig. 11.
— — *Balkwill and Wright*, 1885. Trans. R. I. Acad., vol. xxviii (Sci.), p. 341, pl. xii, fig. 22.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, No. 7, p. 223, pl. xliv, fig. 23.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 335, pl. x, fig. 85, and figs. 19, 87, and 88 (?), named *seminiformis*, but not described.
— serrata, *Schlumberger*, 1894. Mém. Soc. Zool. Fr., vol. vii, p. 258, pl. iii, fig. 7.

Characters.—Although homologous, the *cellulated* margin of Williamson's *ornata* is sufficiently distinct from the *tubulated* margin of his *lagenoides* to make the adoption of the latter name preferable.

Occurrence.—*Lagena lagenoides* has a considerable geographical and bathymetrical range. It is not uncommon off the coasts of the British Isles, appears to be more common in the North Atlantic, and occurs with less frequency in the South Atlantic and South Pacific. The depths from which it has been obtained range between 38 and 2740 fathoms.

Fossil specimens have been recorded from the Miocene of Messina (Seguenza), and from the Pleistocene of Canada and the North-east of Ireland. The Crag specimens were obtained from Sutton.

20. LAGENA FORMOSA, *Schwager*, 1866. Plate VI, fig. 6.

LAGENA FORMOSA (pars), *Schwager*, 1866. Novara-Exped. Geol., vol. ii, p. 206, pl. iv, figs. 19 *a* and *d* (Young ?).
— — *Brady*, 1884. Report 'Challenger,' pp. 447 and 480, pl. lx, figs. 10, 18—20; 8 ? and 17 ?

Characters.—Body long, flask-shaped, compressed, with tubulated wing, frequently emarginate at the base, and with a raised border immediately surrounding the body on both sides of the shell. Our example from the Crag is destitute of the fine broad flange or wing present in more typical specimens.

Occurrence.—*Lagena formosa* was found by the 'Challenger' at several stations, but for the most part in very deep water, 1075 to 2750 fathoms. Small or broken specimens were found in the Southern Ocean at depths of 50—150 fathoms. As a fossil it has previously been recorded only from the Pliocene of Kar-Nicobar. We have, however, large specimens from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have found it (but rarely) in every zone examined except at Aldborough (zone **g**).

20*. LAGENA FORMOSA, *Schwager*, var. COMATA, *Brady*, 1884. Plate VII, fig. 7.

LAGENA FORMOSA, var. COMATA, *Brady*, 1884. Report 'Challenger,' pp. 447 and 480, pl. lx, fig. 22.

Characters.—Form similar to that of *L. formosa*, but the body of the shell is marked with longitudinal striæ and thin rugulæ in Brady's fig. 22. Although our specimen from the Crag is marked with fewer and coarser costulæ, and has no broad marginal flange, yet it evidently comes into the same category of sub-varieties of the *lagenoides* sub-type as the foregoing forms.

Occurrence.—*Lagena formosa*, var. *comata*, Brady. This sub-variety, characterised by the striate surface of the body-chamber, was first recorded in the 'Challenger' Report from the North Pacific (1850 fathoms). We have found a well-developed specimen in the Scaldisian of Antwerp. The example figured in Plate VII, fig. 7, is from Sutton, zone **f**.

21. LAGENA ANNECTENS, sp. nov., *Burrows and Holland.* Plate VII, figs. 11 *a*, *b*.

> LAGENA LÆVIGATA, pars, *Reuss*, 1870. Sitz. k. Ak. Wiss. Wien, vol. lxii, p. 16.
> FISSURINA, No. 75, *Schlicht*, 1870. Pietzpuhl, p. 13, pl. v, figs. 7—9.
> LAGENA QUADRICOSTULATA, pars, *Brady* (non *Reuss*), 1884. Report 'Challenger,' p. 486, pl. lix, fig. 15.

Characters.—Test pyriform, compressed, entosolenian, aperture fissurine; periphery carinate or non-carinate, sometimes notched at the aboral extremity. Each face of the test ornamented with two narrow curved surface-markings or shallow sulci, parallel with the margins, and occasionally uniting in a horseshoe form.

This species at first sight bears a strong resemblance to *L. quadricostulata*, Reuss; but the ornamentation consists not of arched costulæ, as in the latter species, but of marks apparently due to a structural difference in the shell-substance along the lines of the curves on the surface. In recent and some fossil specimens, where the test is clear and glassy, the markings have the appearance of frosted bands. This is well shown in Schlicht's figures quoted above, and in several of the 'Challenger' specimens which are preserved in the British Museum, and which we have carefully examined. It is possible that this effect is produced by minute tubuli in the shell-walls; but we have as yet been unable satisfactorily to determine this point. In fossil specimens the "frosted" bands are sometimes replaced by shallow sulci, probably due to an erosion of the shell-substance along the line of the bands.

Lagena annectens must not be confounded with *L. lucida*, Williamson. The general contour of the shells differs considerably, *L. annectens* being more robustly built. Moreover, the "milky white" horseshoe-shaped bands in *L. lucida* occupy a much greater relative proportion of the shell surface, and the internal tube, so strikingly apparent in *L. lucida*, is hardly, if at all, developed in any of our specimens of *L. annectens*, recent or fossil.

Occurrence.—The 'Challenger' specimens were obtained off Kerguelen Island (20 to 120 fathoms), and off Sydney (410 fathoms). Schlicht's specimens, described by Reuss, were from the Oligocene of Pietzpuhl. The Crag specimen is from Tattingstone, zone **d**.

22. Lagena Orbignyana (*Seguenza*), 1862. Plate VII, figs. 13 *a*, *b*.

Entosolenia marginata (pars), *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 9, pl. i, figs. 19, 20.
Fissurina Orbignyana, *Seguenza*, 1862. Foram. Monotal. Messin., p. 66, pl. ii, figs. 25, 26.
— Romettensis, *Idem*, 1862. Ibid., fig. 24.
— Gemellarii, *Idem*, 1862. Ibid., p. 70, pl. ii, fig. 45.
Lagena tricincta, *Gümbel*, 1868. Abhandl. k. Bayer. Akad. Wiss., vol. x, p. 606, pl. i, figs. 8 *a*, *b*.
Fissurina marginata, var. tricarinata, *Reuss*, 1870. Sitzungsb. k. Akad. Wiss. Wien, vol. lxii, p. 468, No. 19 *a*.
Lagena, No. 63, *Schlicht*, 1870. Pietzpuhl, p. 11, pl. iv, figs. 1—3 (ectosolenian form).
Fissurina tricincta, *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, Mém. 3, p. 30, pl. i (ix), figs. 19 *a*, *b*.
— tricarinata, *Idem*, 1882. Ibid., p. 32, pl. i (ix), figs. 25—28.
Lagena marginata, var. Orbignyana, *Wright*, 1882. Proc. Belfast Nat. Field Club, App. vi, p. 181, pl. viii, fig. 5.
Fissurina marginata, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, Mém. 3, p. 30, pl. i (ix), figs. 20—22.
Lagena Orbignyana, *Brady*, 1884. Report 'Challenger,' pp. 447 and 484, pl. lix, figs. 1, 18, 24—26; winged variety, fig. 20.
— — *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 82, pl. iii, fig. 1.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 222, pl. xliv, fig. 20.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 333, pl. x, figs. 89—91.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 82.

Characters.—This close ally of *L. marginata* has three parallel keels, of which the central one is usually the widest.

Occurrence.—*Lagena Orbignyana* has a world-wide distribution and a very extensive bathymetrical range; but it is less frequently found in high latitudes. The species was first described by Seguenza from the Miocene of Messina. It has been recorded from the Eocene (Calcaire Grossier) of the Paris Basin, the Oligocene of Pietzpuhl, the Pliocene of Piedmont and St. Erth, and the Post-Tertiary beds of Ireland. We have found specimens also in the Scaldisian of Antwerp. In the Coralline Crag we have found it sparingly in nearly all the zones examined.

23. Lagena lacunata, sp. nov., *Burrows and Holland.* Plate VII, figs. 12 *a*, *b*.

Lagena castrensis, *Brady* (non *Schwager*), 1884. Report 'Challenger,' vol. ix, p. 485, pl. lx, figs. 1—3 ?
— — *Balkwill and Wright* (non *Schwager*), 1885. Trans. R. I. Acad., vol. xxviii (Sci.), p. 341, pl. xii, figs. 20, 21.

Characters.—Test compressed, nearly circular, tapering slightly towards the oral end, periphery tricarinate; body of test biconvex; ornamented externally with shallow pittings irregularly disposed; aperture ectosolenian and fissural.

This is a modification of *L. Orbignyana* (Seguenza), and is distinguished from *L. castrensis,* Schwager, with which it has been confounded by the authors mentioned above, by the substitution of shallow pittings for exogenous beads. Brady, in the 'Challenger' Report, describes his specimens as ornamented with "large exogenous beads irregularly scattered over the lateral faces of the test." The figures in his pl. lx, however, show a surface ornamentation of shallow pittings. We have carefully examined the figured 'Challenger' specimens which are preserved in the British Museum, and we find that they agree with the plates, and not with the description in the text. We are confirmed in this view by Mr. Hollick, the artist who prepared the 'Challenger' plates from the actual specimens.

Messrs. Balkwill and Wright give no description of the specimens mentioned in their paper, but the figures in their pl. xii, which were also drawn by Mr. Hollick, clearly show pittings. Mr. Wright has kindly sent his specimens for our inspection, and we find that they exactly agree with our own examples of *L. lacunata.*

This species is approached by *Lagena* (*Entosolenia*) *variolata*, Schlumberger, and by *Lagena* (*Fissurina*) *punctata*, Seguenza; but the pittings upon both these species are relatively much smaller, and are arranged with marked regularity; whereas in *L. lacunata* the pittings are relatively large, few in number, irregular in outline, and irregularly disposed.

Occurrence.—In the recent condition *L. lacunata* appears to be somewhat rare. Dr. Brady's specimens were obtained from four 'Challenger' stations, namely, "off East Moncœur Island, Bass Strait, 38 fathoms; off Raine Island, Torres Strait, 155 fathoms; off Amboyna, 15 to 20 fathoms; and the *Hyalonema*-ground, south of Japan, 345 fathoms." It has also been found off the Irish coast, 45 to 50 fathoms.

In our own Collections we have fossil specimens from the Casterlian and Scaldisian formations at the Kattendyk Docks, Antwerp. In the Coralline Crag

we have found it somewhat commonly at Tattingstone, zone **d**; and also, but more rarely, at Sudbourne Hall and Broom Hill, zone **d**; at Sutton, zone **e**; and Gedgrave, zone **f**.

Mr. Wright, of Belfast, informs us that this species has been found also on the shore, at extreme low water, at Southport, Lancashire, as mentioned by Mr. G. W. Chaster, in the 'Report Southport Society Nat. Science' for 1890–91 (1892), p. 62 ("*L. castrensis*").

Sub-family 2.—Nodosariinæ.

Brady, Report 'Challenger,' 1884, *pp.* 69 *and* 488.

General Characters.—Test polythalamous; straight, arcuate, or plano-spiral.

There are but few from among the numerous so-called genera and sub-genera of this family that have to be noticed here. Belonging to the type *Nodosaria* there are from the Crag only the following:

1. *Glandulina*, referred by some direct to *Nodosaria*.
2. *Nodosaria* (proper).
3. *Dentalina*, often regarded as *Nodosaria*.
4. *Vaginulina*.
5. *Marginulina*.
6. *Cristellaria*.

Ten figures of good examples of noticeable varieties have been added (in Pls. V, VI, and VII) to those noticed in Part I. The lists of synonyms have, of course, greatly increased since 1866.

The genus *Nodosarina* (Part I, 1866, p. 46), proposed by Parker and Jones in 1859, although scientifically applicable to the manifold series of subtypical forms which it was intended to comprise, has not been widely adopted; the appellations of the sub-types, such as *Glandulina*, *Nodosaria*, &c., being more readily and conveniently used in a *quasi*-generic sense. They all also fall into the recognised sub-family of "*Nodosariinæ*." For convenience, therefore, the terms *Glandulina*, *Nodosaria*, and others are used here as generic or subgeneric, as in many other memoirs and monographs. It is further most convenient to retain the use of the names of even subordinate sub-types, such as *Dentalina*, &c., as occasion seems to require, although their slight differential characters are not of real zoological value; but, just as with other Foraminifera, slight modifications serve to differentiate them artificially.

In the 'Ann. Mag. Nat. Hist.,' ser. 3, vol. iii, 1859, pp. 476, 477, *Nodosarina* was adopted by Parker and Jones (and by Carpenter, 'Introd. Foram.,' 1862, p. 156) as a broad generic term for the great group of hyaline Foraminifera

comprising *Nodosaria*, *Cristellaria*, and eight or more sub-genera, or so-called "genera;" by Jones, in the 'Monthly Microscop. Journ.,' vol. xv, 1876, p. 90, for fourteen sub-genera; and by H. B. Brady, in his 'Monograph of Carboniferous and Permian Foraminifera,' Pal. Soc., 1876, p. 122, for twelve and more sub-genera; but its use has not been found generally convenient. Dr. A. Goës, however, as an exponent of real biological relationship, in his highly valuable and physiological revision of accepted "genera" and "species," uses this term in his memoir "On the Reticularian Rhizopoda of the Caribbean Sea" ('Kongl. Svenska Vetenskaps-Akad. Handl.,' vol. xix, No. 4, 1882). Dr. A. Hosius also uses it as a generic term for seven forms in the 'Verhandl. Nat. Ver. Preuss.-Rhein.,' 1892, p. 152, &c.; it is also adopted by M. F. Bernard in his 'Élém. Paléont.,' part 1, 1893, p. 92.

Genus[1] 1.—Glandulina, *d'Orbigny*, 1826.

Brady, Report 'Challenger,' 1884, *pp.* 490—494.

Part I, 1866, p. 47.

Additional Synonyms:

Glandulina.—*Neugeboren, Costa, Fornasini, Stache, Terquem, Berthelin, Egger, Schwager, Dunikowski, Blake, Alth, Hantken, Roemer, Deecke, Quenstedt, Bronn, Bütschli, Schlumberger, Haeusler, Olszewski, Uhlig, Hitchcock, Karrer, Marsson, Dervieux, Guppy, and others.*

Nodosaria.—*Reuss, Parker and Jones, Brady, Goës, de Amicis, and others.*

1. Glandulina lævigata, *d'Orbigny*, 1826. Plate I, figs. 1—3.

Part 1, 1866, p. 47, No. 1; Appendix II, Table, No. 35.

Additional Synonyms:

Cornu Hammonis erectum globosius, *Plancus*, 1739. Conch. minus notis, &c., p. 16, pl. ii, figs. 3, d, e, f; and edit. 2, 1760, p. 19, pl. ii, figs. d, e, f.

Nuclei, &c., *Soldani*, 1780. Saggio Orittogr., p. 107, pl. v, fig. 39, t?

Orthocerata unilocularia, &c., *Idem*, 1780. Ibid., p. 108, pl. vi, fig. 45, o; pl. vii, figs. 45, v, x, and 46, a (?).

Testæ *Cordiformes, Soldani*, 1791. Testaceogr., vol. i, part 2, p. 92, pl. xcvi, fig. z?

Orthoceras *cordiforme læve, Idem*, 1791. Ibid., p. 98, pl. civ, fig. d.

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[1] *Quasi*-generic only.

Polymorpha *Subovalia, Soldani*, 1791. Ibid., vol. i, part 2, p. 115, pl. cxvii, fig. *r.*

— *Sphærulæ vitreæ læves, Soldani*, 1791. Ibid., vol. i, part 2, p. 115, pl. cxviii, fig. E.

Testæ oviformes, glandiformes, &c., *Soldani*, 1798. Ibid., vol. ii, p. 17, pl. iii, figs. *dd, hh, ii* (?).

— ovales, oliviformes, pyriformes, fusiformes, &c., *Soldani*, 1798. Ibid., vol. ii, p. 37, pl. xii, fig. I.

GLANDULINA INFLATA, *Costa*, 1838. Fauna Reg. Nap., p. 14, pl. iv, fig. 1.

— LÆVIGATA, *Reuss*, 1846. In Geinitz Grundr. Verst., p. 651, pl. xxiv, fig. 1.

NODOSARIA (GLANDULINA) LÆVIGATA, *Reuss*, 1846. Ibid., p. 652, pl. xxiv, fig. 5.

GLANDULINA HAIDINGERINA, *Neugeboren*, 1850. Verh. Mitth. Siebenburg Ver. Nat., vol. i, p. 48, pl. i, fig. 2.

— LÆVIGATA, *Bronn*, 1856? Leth. Geogn., edit. 3, vol. iii, p. 242, pl. cccliii, figs. 3 *a, b.*

— — *Neugeboren*, 1856. Denksch. k. Akad. Wiss. Wien, vol. xii, part 2, p. 67, pl. i, figs. 3, 4.

— INFLATA, *Costa*, 1856. Pal. Reg. Nap., p. 126, pl. xi, fig. 21.

— ACUMINATA, *Costa*, 1856. Ibid., p. 125, pl. xi, fig. 19.

NODOSARIA (GLANDULINA) LÆVIGATA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 280, pl. x, figs. 6—8, and 9, var.

GLANDULINA LÆVIGATA, *Carpenter, Parker, and Jones*, 1862. Introd. Foram., pl. xii, fig. 5.

NODOSARIA (GLANDULINA) LÆVIGATA, *Parker and Jones*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 439.

GLANDULINA LÆVIGATA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 468, pl. xlviii, fig. 7.

NODOSARIA (GLANDULINA) LÆVIGATA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 340, pl. xiii, fig. 1.

GLANDULINA LÆVIGATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 47, pl. i, figs. 1—3.

— — (TYPICA), *Reuss*, 1870. Sitz. Akad. Wiss. Wien, vol. lxii, pp. 477, 478; *Schlicht*, Pietzpuhl, 1870, Nos. 85, 86, pl. vi, figs. 7, 8.

— Nos. 80—82, 84—87, *Schlicht*, 1870. Pietzpuhl, pp. 15, 16, pl. vi, figs. 1—3, 5—8.

— LÆVIGATA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 295.

— — *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 153, pl. ix, fig. 34.

— — *Hantken* (1876), 1881. Mitth. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, p. 40, pl. iv, fig. 7.

— — *Schwager*, 1877. Boll. R. Comm. Geol. Ital., vol. viii, p. 25, pl. o, fig. 6.

— — *Terquem*, 1878. Mém. Soc. Géol. France, ser. 3, vol. i, p. 12, pl. i (vi), fig. 3.

GLANDULINA LÆVIGATA, *Bütschli*, 1880. In Bronn's Klassen, &c., p. 197, pl. vii, fig. 25.
— — *Schlumberger*, 1882. Feuil. Jeune Nat., part 1, fig. 6.
— — *Jones*, 1883. Microgr. Dict., ed. 4, p. 357, pl. xxiii, figs. 28 *a*, *b*.
— ELONGATA, *Schwager*, 1883. Palæontographica, vol. xxx, p. 107, pl. iii, fig. 7.
— LÆVIGATA, var. INFLATA, *Andreae*, 1884. Abh. geol. Specialkarte Elsass-Loth., p. 206, pl. vii, fig. 12.
— — *Idem.*, 1884. Ibid., p. 206, pl. x, fig. 22.
NODOSARIA (GLANDULINA) LÆVIGATA, *Brady*, 1884. Report 'Challenger,' p. 490, pl. lxi, figs. 17—22, 32, including varieties. (Figs. 20—22, *typica*.)
GLANDULINA LÆVIGATA, *Gümbel*, 1885. Geol. Bayern, vol. i, part 2, p. 421, fig. 2664.
NODOSARIA (GLANDULINA) ABBREVIATA, *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc., p. 746, pl. xiv, fig. 20.
GLANDULINA LÆVIGATA, *Haeusler*, 1887. N. Jahrb. for 1887, part 1, p. 189, pl. v, figs. 29, 30.
NODOSARIA (GLANDULINA) LÆVIGATA, *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Micros. Soc., p. 556, pl. ix, figs. 14, 15.
GLANDULINA LÆVIGATA, *Crick and Sherborn*, 1891. Journ. Northamp. Nat. Hist. Soc., vol. vi, p. 209, pl. vi, fig. 4.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, pp. 336 and 339, pl. xi, fig. 31.
NODOSARIA LÆVIGATA, *de Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 353 and 470.
— — *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, p. 597, pl. v, figs. 1, 2.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 71, pl. xiii, figs. 702, 703, 706, 707, 709.
GLANDULINA CUSPIDATA, *Franzenau*, 1894. Glasnik Hrvatskoga Naravoslovnoga Družtva (Proc. Soc. Hist.-Nat. Croatica), p. 259, pl. v, fig. 5.
NODOSARIA (GLANDULINA) LÆVIGATA, *de Amicis*, 1895. Nat. Sicil., vol. xiv, p. 21.

Characters.—Few-chambered, compact, short, ovate with pointed base, or more or less fusiform; transverse section circular; aperture terminal and central.

Besides the recognised *Gl. lævigata*, d'Orb., Brady gives (Report 'Challenger,' pp. 490—494) particulars of numerous varieties and sub-varieties of this subtypical form.

Occurrence.—*Glandulina lævigata* has a very wide range in recent seas, both as regards latitude and depth of water. It is specially abundant in the northern

portion of the North Atlantic (at 50 to 1360 fathoms). The greatest depth at which it has been found is 1375 fathoms, in the Southern Ocean.

As a fossil its first recorded appearance is from the Lias[1] of Leicestershire (?); it has also been found in the Oxford Clay of Leighton Buzzard; the Kimmeridge Clay of Aylesbury; the Gault of Folkestone; the Red Chalk of Speeton; the Upper Chalk of Keady Hill, Ireland; the London Clay (Eocene); the Oligocene of Elsass; the Miocene of Vienna, Italy, and Muddy Creek, Victoria; the Pliocene of Garrucha (South Spain), Italy, and St. Erth. In the Coralline Crag it has been found at Sutton only.

Genus 2.—Nodosaria, *Lamarck*, 1816.

Brady, Report 'Challenger,' 1884, *pp.* 69 *and* 488.

Part I, 1866, p. 48.

Additional Synonyms:

Nautilus.—*Martini.*
Encorycium.—*Ehrenberg.*
Nodosarina.—*Parker and Jones.*
Frondicularia, pars.—*Berthelin.*
Nodosaria.—*Cuvier, Bowdich, Ansted, Mantell, Eley, Silvestri, Hantken, Schwager, Olszewski, Sherborn, Chapman, Gümbel, Mariani, Zwingli and Kübler, Fric, Andreae, Gemmellaro, Suess, Zittel, Schlumberger, Bütschli, Prestwich, Reeve, Terrigi, Pictet, Fornasini, Franzenau, Boll, Buvignier, Schmid, Marsson, Cornuel, Basset, Goës, Agassiz, Hamilton, Malagoli, Richter, Dunikowski, Rouault, Deecke, Toutkowsky, Howchin, Steinmann, Hartwig, Mackie, Nicholson, Hoernes, Balkwill, Wright, Smedley, Beudant, Geinitz, Hagenow, Blake, Pilla, Uhlig, Hitchcock, Chimmo, Haeusler, Koenen, Quenstedt, Seguenza, Dervieux, de Amicis, Millett, Guppy, and others.*

General Characters.—Chambers, few or many, in linear succession; cylindrical or tapering; more or less septate; smooth or ornamented; aperture terminal, central, often produced. Straight forms = *Nodosaria;* arcuate forms = *Dentalina.*

[1] See the foot-note at page 161 regarding the Liassic specimens formerly supposed to have come from the Trias of Chellaston.

PLATE V.

Fig.

1. *Biloculina depressa*, d'Orb. × 24.
2. *Spiroloculina excavata*, d'Orb. × 24.
3. — *nitida*, d'Orb., Variety. × 24.
4. *Miliolina circularis* (Bornemann). × 24. Mr. F. Chapman's Collection.
5. — *oblonga* (Montagu). × 24. Mr. F. Chapman's Collection.
6. *Nodosaria obliqua* (Linné). × 12.
7. *Vaginulina linearis* (Montagu). × 12.
8. — *lævigata*, Römer. × 12.
9. — *obliquestriata*, sp. nov., J. × 12.
10. — — — × 12.
11. — — — × 12.
12. *Haplophragmium glomeratum* (?), Brady. × 48. Mr. F. Chapman's Collection.
13. *Textilaria gibbosa*, d'Orb. × 12.
14. — — — × 12.
15. — *sagittula*, Defrance, Variety. × 24.
16. — — — × 12.
17. — *tuberosa*, d'Orb. × 12.
18. — *sagittula*, Defrance. × 24.
19. — *jugosa*, Brady. × 24.
20. — *sulcata*, sp. nov., J. × 24.
21. — *subflabelliformis*, Hantken. × 24.
22. *Polymorphina concava*, Williamson. × 48. Mr. F. W. Millett's Collection.
23. — *problema*, d'Orb. × 12.
24. — *communis*, d'Orb. × 12.
25. — *turgida*, Reuss. × 12.
26. — *compressa*, d'Orb. (encrusted). × 12.
27. — *variata*, Jones, Parker, and Brady. × 12.
28. — *compressa*, d'Orb., Variety. × 12.
29. — *tuberculata*, d'Orb. × 48. Mr. F. Chapman's Collection.
30. *Planorbulina Mediterranensis*, d'Orb. × 48.
31. *Truncatulina refulgens* (Montfort). × 48. Mr. F. Chapman's Collection.
32. *Nonionina umbilicatula* (Montagu). × 36. Mr. F. Chapman's Collection.
33. *Operculina ammonoïdes* (Gronovius), Var. *curvicamerata*, nov., J. × 36. Mr. F. Chapman's Collection.

Excepting Figs. 4, 5, 12, 22, 29, 31, 32, 33, the specimens here figured are from the Searles-Wood Collection in the British Museum. All from the Coralline Crag.

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FORAMINIFERA OF THE CRAG.

PLATE VI.

Fig.

1 *a*, *b*. *Biloculina elongata*, d'Orb. × 12. Cor. Crag, Sudbourne Hall.

2 *a*, *b*. *Miliolina triangularis* (d'Orb.). × 30. Cor. Crag, Sudbourne Hall.

3 *a*, *b*. — *pulchella* (d'Orb.). × 60. Cor. Crag, Broom Hill.

4 *a*, *b*. — *Cuvieriana* (d'Orb.). × 36. Cor. Crag, Gomer (Gedgrave).

5. *Peneroplis planatus* (F. and M.). × 60. Cor. Crag, Broom Hill.

6 *a*, *b*. *Lagena formosa*, Schwager. × 60. Cor. Crag, Broom Hill.

7. — *hexagona*, Williamson. × 70. Cor. Crag, Sudbourne Hall.

8 *a*, *b*. — *seminuda*, Brady. × 70. Cor. Crag, Sudbourne Hall.

9 *a*, *b*. *Nodosaria raphanus* (Linné). × 60. Cor. Crag, Sudbourne Hall.

10 *a*, *b*. — — — × 60. Cor. Crag, Sudbourne Hall.

11. — *ambigua*, Neugeboren. × 60. Cor. Crag, Sudbourne Hall.

12 *a*, *b*. *Polymorphina problema*, d'Orb., × 60. Cor. Crag, Sudbourne Hall.

13 *a*, *b*. — *sororia*, Reuss. × 60. Cor. Crag, Broom Hill.

14 *a*, *b*. — *hirsuta*, Brady, Parker, and Jones. × 60. Cor. Crag, Broom Hill.

15 *a*, *b*. — *cylindroïdes*, Römer. × 30. Cor. Crag, Broom Hill.

16 *a*, *b*. — *communis*, d'Orb. × 15. Cor. Crag, Broom Hill.

17 *a*, *b*. *Textilaria agglutinans*, d'Orb., Var. *densa*, nov., J. × 30. Cor. Crag, Broom Hill.

18 *a*, *b*, *c*. — *globulosa*, Ehrenberg. × 75. Chillesford Sand, Aldeby.

19. *Bulimina elegans*, d'Orb., Variety. × 60. Cor. Crag, Sudbourne Hall.

20. *Virgulina Schreibersiana*, Czjzek, Var. *obesa*, nov., J. × 15. Cor. Crag, Sudbourne Hall.

21. *Bolivina Ænariensis* (Costa). × 70. Cor. Crag, Sudbourne Hall.

22. *Spirillina vivipara*, Ehrenberg, Var. *unilinearis*, nov., J. × 70. Cor. Crag, Broom Hill.

23. *Truncatulina variabilis*, d'Orb. × 60. Cor. Crag, Broom Hill.

Excepting Fig. 4 (in Mr. F. W. Millett's Collection), the specimens figured in this Plate are in the Collections of Mr. H. W. Burrows and Mr. R. Holland, who kindly communicated the drawings. All except Fig. 18 are from the Coralline Crag.

H. W. Burrows
F. Holland } del ad nat

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FORAMINIFERA OF THE CRAG

PLATE VII.

Fig.

1 *a, b, c.* *Biloculina inornata*, d'Orb. × 60. Sutton.

2 *a, b.* *Sigmoilina tenuis* (Czjzek). × 60. Sutton.

3\. *Peneroplis cylindraceus* (Lamarck). × 60 ? Sudbourne.

4\. *Orbiculina adunca* (F. and M.). × 30. Sutton.

5\. *Lagena clavata*, d'Orb. × 60. Sutton.

6 *a, b.* — *gracilis*, Williamson. × 60. Tattingstone.

7\. — *formosa*, Schwager, Var. *comata*, Brady. × 60. Sutton.

8\. — *striata*, d'Orb. × 60. Sutton.

9 *a, b.* *Lagena quadrata*, Williamson, Variety. × 60. Broom Hill.

10\. — *seminiformis*, Schwager. × 100. Broom Hill.

11 *a, b.* — *annectens*, sp. nov., Burrows and Holland. × 70. Tattingstone.

12 *a, b.* — *lacunata*, sp. nov., Burrows and Holland. × 70. Tattingstone.

13 *a, b.* — *Orbignyana* (Seguenza). × 60. Tattingstone.

14 *a, b.* — *lævigata* (Reuss). × 60. Tattingstone.

15\. *Nodosaria proxima*, Silvestri. × 60. Gedgrave.

16 *a, b.* *Rhabdogonium tricarinatum*, Reuss. × 60. Sutton.

17 *a, b.* *Dimorphina compacta*, B., P., & J. × 70. Gedgrave.

18 *a, b.* *Cristellaria reniformis*, d'Orb. × 60. Sutton.

19 *a, b.* — *gibba*, d'Orb. × 60. Sutton.

20\. *Polymorphina frondiformis*, S. V. Wood, Var. *brevis*, nov., J. × 15. Gedgrave.

21\. *Dimorphina tuberosa*, d'Orb. × 12. Sutton.

22 *a, b.* *Polymorphina complanata*, d'Orb. × 60. Sudbourne Hall.

23 *a, b, c.* *Globigerina Linnæana* (d'Orb.). × 60. Sudbourne Hall.

24 *a, b.* *Textilaria conica*, d'Orb. × 60. Sudbourne Hall.

25\. *Spiroplecta rosula*, Ehrenberg. × 70. Gedgrave.

26\. *Uvigerina angulosa*, Williamson. × 60. Sudbourne Hall.

27\. — *Canariensis*, d'Orb., Var. *farinosa*, Hantken. × 100. Tattingstone.

28 *a, b, c.* *Discorbina globularis* (d'Orb.). × 70. Tattingstone.

29 *a, b, c.* — *turbo* (d'Orb.). × 70. Broom Hill.

30 *a, b, c.* *Anomalina grosserugosa*, Gümbel, Variety. × 60. Sudbourne Hall.

31 *a, b, c.* *Discorbina orbicularis* (Terquem). × 70. Sutton.

32 *a, b.* *Pulvinulina elegans* (d'Orb.). × 70. Sudbourne Hall.

33 *a, b, c.* *Discorbina lingulata*, sp. nov., Burrows and Holland. × 70. Sutton.

34 *a, b.* *Operculina ammonoïdes* (Gronovius). × 100. Gedgrave.

35 *a, b.* *Polystomella macella* (F. and M.). × 30. Broom Hill.

Excepting Fig. 3 (after a sketch by H. B. Brady), the figures in this Plate were drawn by Messrs. Burrows and Holland from specimens in their own Collections. All are from the Coralline Crag.

PL.VII.

H.W.Burrows } del ad nat
R.Holland

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FORAMINIFERA OF THE CRAG.

Foraminifera

THE

PALÆONTOGRAPHICAL SOCIETY.

T. Rupert Jones
Foraminifera of the Crag
Part III

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A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

PART III.

CONTAINING

PAGES ix—xii; 211—314.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

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CONTENTS.

LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED IN PART III.

WOODCUT IN PART III.

CORRECTIONS FOR PART II.

Page vi, line 15 from top, for *Polystomella (Nonionina) scapha* read *Nonionina scapha.*
„ „ „ 25 „ „ *Dentritina* read *Dendritina.*
„ 93, in foot-note, *for* p. 21 *read* p. 96.
„ 108, last line of synonyms, *for* p. 35 *read* p. 109.
„ 137, line 15 from top, *for* fig. 10 *read* fig. 16.
„ 177, line 9 from bottom of text, *for* figs. 8 and 9, *add* note:

In the 'Rivista Ital. Paleont.,' June, 1896, Signor C. Fornasini, having examined the original specimens, states that Costa's fig. 8 is probably either a *Polymorphina* or an incipient *Marginulina;* and that Costa's fig. 9 is a *Glandulina.*

CORRECTIONS FOR PART III.

Page 221, line 9 from top, *for* Vignettes *read* Vignette 1.
„ 226 „ 21 „ Cornu Hammonis should not have been printed in capitals.
„ 229, heading and line 11 from top, *for* LINARIS *read* LINEARIS.
„ 250, line 7 from bottom, in foot-note, *for* laxum *read* laxus.
„ 253 „ 2 „ „ „ *after* Zelanti, *add* Acireale.
„ 257 „ 2 „ in the text, *for* Neapol. *read* Neapel (without the full stop).
„ 271 „ 5 „ *after* BREVIS *add* nov., *Jones.*
„ 272 „ 1 *after* LINEATA *add* nov., *Jones.*
„ 278 „ 17 from top, *after* Appendix *add* I, Table, No. 59; and *for* Tables *read* Table.
„ 288 „ 4 „ *for* ROTALIDÆ *read* ROTALIIDÆ.
„ 290 „ 10 „ *after* nov. *add Jones.*
„ „ „ 11 from bottom, *for* ROTALINÆ *read* ROTALIINÆ.
„ 293 „ 6 from top, *for* Neapol *read* Neapel.
„ 306 „ 18 from bottom, *after* Selsk. *add* Christiania.
„ 312 „ 3 from top, *for* often *read* sometimes.
„ „ „ 5 „ *delete* blunt.
„ „ „ 8 „ *delete* indefinite.
„ „ lines 12 and 13 from top, *for* the few *read* some of those which.
„ „ line 13 from top *delete* (from Sutton and Sudbourne).

1. Nodosaria ambigua, *Neugeboren*, 1856. Plate VI, fig. 11.

Orthocerata, *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. 43, L; and (Hortoceratia) Testaceogr., vol. ii, 1798, Appendix, p. 141, pl. vi, fig. 43, L (fossil).

Orthoceratia *Baculi*, *Soldani*, 1791. Testaceogr., vol. i, part 2, pp. 96, 97, pl. cii, figs. *zz*[1] and A; and pl. ciii, figs. E, F, G, H, and P?

Orthocera ?, *Woodward*, 1833. Geol. Norfolk, p. 60, pl. vi, fig. 24.

Nodosaria subæqualis, *Costa*, 1855. Mem. Accad. Sci. Napoli, vol. ii, p. 140, pl. i, fig. 5.

— ambigua, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 137, pl. xii, figs. 9 *a*, A, and var. figs. 10 a, A.

— — *Neugeboren*, 1856. Densksch. k. Akad. Wiss. Wien, vol. xii, part 2, p. 71, pl. i, figs. 13—16.

— texana, *Conrad*, 1857. Report U.S. and Mexican Boundary Survey, vol. i, part 2, p. 159, pl. xiv, figs. 4 *a*, *b*, *c*.

— tornata, *Schwager*, 1865. Novara-Exped. Geol. Theil, vol. ii, p. 223, pl. v, fig. 51.

— subæqualis, *Silvestri*, 1872. Atti Accad. Gioen. Sci. Nat., n. s., vol. vii, p. 91, pl. xi, figs. 260—263.

— moniliformis, *Ehrenberg*, 1873. Abh. k. Akad. Wiss. Berlin, p. 390, pl. vi, III, fig. 11.

— radicula, var. ambigua, *Brady*, 1884. Report 'Challenger,' p. 496, pl. lxii, fig. 3.

— ambigua, *Fornasini*, 1889. Foram. Mioc. S. Rufillo, pl. i, fig. 8; and fig. 9, var. (= *Lingulina rotundata*, d'Orb).

— radicula, var. ambigua, *Sherborn and Chapman*, 1889. Journ. Roy. Micr. Soc. for 1889, p. 486, pl. xi, fig. 16.

— ambigua, var. subæqualis, *Fornasini*, 1890. Mem. Accad. Sci. Bologna, ser. 4, vol. x, p. 467, pl. o, fig. 5.

— — var. annulata, *Fornasini*, 1890. Ibid., ser. 4, vol. x, p. 467, pl. o, figs. 3, 4, 6, 7.

— — — *Mariani*, 1891. Boll. Soc. Geol. Ital., vol. x, fasc. 2, p. 172, pl. vi, fig. 4.

— radicula, var. ambigua, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, pp. 601 and 625, pl. v, fig. 8,

— ambigua, *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 207, pl. i, fig. 2 (= *N. subæqualis*, Costa[2]).

— — *De Amicis*, 1895. Naturaliste Sicil., vol. xiv, p. 21.

[1] Fig. *zz* is probably the same as *Nodosaria clava*, Costa, 'Atti Acc. Pont.,' vol. vii, 1856, p. 146, pl. xiii, fig. 7; and fig. A, *N. cylindracea*, Costa, ibid., fig. 6; both closely allied to *N. ambigua*.

[2] For the determination of the species in O. G. Costa's Collection see C. Fornasini's discriminative memoir in the vols. iv and v (1894–5) of the work quoted.

Characters.—Our small specimen from the Crag consists of four short, almost equal chambers, broader than long, closely set one on another. Zoologically it is a variety of *N. radicula* (Linné) ; it has many slight modifications of shape, and is closely allied to other forms belonging to the same group.

Among the figured forms we find that figs. 9 and 10 of E. Dervieux's pl. v are also referred to *ambigua* at p. 625. *Nodosaria De-Amicis*, Derv., on the same plate, figs. 63, 63 *bis*, though larger, papillose, and mouth-tubed, is *specifically* the same.

In the numerous figures given by Soldani, rough as they are, much of interest is shown among the many varieties of *N. radicula* of this sub-type "*ambigua*." In the fig. L (pl. vi) referred to above, after the large ovoid primordial segment, the four succeeding chambers are short, equal, and closely set. The fig. *zz* (pl. cii) has also a large primordial segment; the later chambers are shorter than broad as in *ambigua*, but are irregular in size and direction of growth. Fig. A (pl. cii) has very short and closely-set chambers; it is much larger than fig. L (pl. vi), and somewhat sinuous in its line of growth. Figs. F, G, H (pl. ciii), also have short close-set chambers; and fig. K combines this feature with that of an obliquely striated *Dentalina*, having put on the chambers of the *radicula* type in later life.

The individual, fig. 4 *c* (*Nodosaria radicula*, parte), in pl. ii, of G. Terrigi's memoir in the 'Mem. Descr. Cart. geol. d' Italia,' vol. iv, part i, 1891, is the same as *N. ambigua.*

Occurrence.—This variety of *N. radicula* lives in the Mediterranean (Soldani), and at 129 fathoms off the Ki Islands ('Challenger'). It occurs fossil, with other *Nodosariæ*, in several Tertiary formations.

The typical *N. radicula* has a wide geographical range, but it has been most frequently recorded from high latitudes, at depths ranging from 10 to 300 fathoms. Specimens have also been obtained from the North and South Atlantic (1360 and 2350 fathoms), from the South Pacific (37 to 1100 fathoms), from off the Cape of Good Hope (150 fathoms), and from the Adriatic.

Its geological range extends back to the Permian of England and Germany. It has also been met with in the Lias of England, in the Kimmeridge Clay, in the Gault of Folkestone, in the Red Chalk of Specton, in the Upper Chalk of Taplow, Bucks, and of Keady Hill, Ireland ; in the London Clay (Eocene) ; in the Miocene of Italy, Vienna, and Malaga ; and in the Pliocene of Italy, Garrucha (South Spain), and St. Erth. In the Coralline Crag it has been found at Sutton ; and at Sudbourne, zone **d**.

2. NODOSARIA RAPHANUS (*Linné*), 1758. Plate I, figs. 4, 5, 22, 23; Plate VI, figs. 9, 10.

Part I, 1866, page 49; and Appendices I and II, Tables, No. 36.

Additional Synonyms:

Corniculum, *Klein*, 1753. Lucubrat. de Test. format. &c., pp. 28 and 44, tabella,[1] figs. A, B.

Orthocerata brevissima in longum striata, &c., *Soldani*, 1780. Saggio Oritt., p. 107, pl. v, figs. 40 *x* X.

Orthoceratia in longum striata, &c., *Soldani*, 1791. Testaceogr., vol. i, pt. 2, p. 91, pl. xciv, fig. T (long form; *Nodosaria rapa*, d'Orb.); fig. V (*Nod. scalaris*, d'Orb., *non* Batsch).

Hortoceratia brevissima in longum striata, &c., *Soldani*, 1798. Testaceogr., vol. ii, Appendix, p. 141, pl. v, figs. 40 *x* X.

NODOSARIA (NAUTILUS) RAPHANUS, *Bowdich*, 1822. Elem. Conch., pt. 1, p. 17, pl. ii, fig. 9.

— SCALARIS, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 253, No. 18 (*non* Batsch, 1791).

— CLAVA, *Michelotti*, 1841. Mem. Soc. Fisica Ital., vol. xxiii, p. 276, pl. i, figs. 4 *a*, *b*.

— PROPINQUA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, pt. 2, p. 151, pl. xiii, fig. 2.

— TURGIDULA, *Idem*, 1856. Ibid., p. 152, pl. xiii, figs. 3 *a*, *C*.

— CONTRACTA, *Idem*, 1857. Mem. Accad. Sci. Napoli, vol. ii, p. 135, pl. i, fig. 3.

— SULCATA, *Idem*, 1857. Ibid., p. 140, pl. i, fig. 4.

— RAPHANUS, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iii, p. 477.

— — — 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 453, pl. xix, fig. 10.

— BACTROIDES, *Reuss*, 1863. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 37, pl. ii, fig. 5.

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[1] This vignette at p. 44 is not numbered. It contains another figure of *N. raphanus* (long var.); and a very long delicate *Nodosaria radicula* (with 23 segments). Among the small figures in the top row, the first and second, and the sixth, appear to be *Rotalia Beccarii*. A and B were in stone from "Gedanum" (Dantzic); all the others probably from Rimini, see p. 10.

NODOSARIA LAMELLOSO-COSTATA, *Reuss*, 1863. Ibid., p. 38, pl. ii, fig. 6.
— PRISMATICA, *Reuss*, 1863. Ibid., p. 36, pl. ii, fig. 7.
NODOSARINA (NODOSARIA) RAPHANUS, *J. and P.*, 1864. Geologist, vol. viii, p. 88.
NODOSARIA RAPHANUS, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 340, pl. xvi, fig. 1.
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 49, pl. i, figs. 4, 5, 22, 23.
— — *Brady*, 1867. Proceed. Somerset Arch. N. H. Soc., vol. xiii, p. 222, pl. i, fig. 6.
— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 156, pl. ix, figs. 39, 40.
— — *Silvestri*, 1872. Atti Accad. Giœnia Sci. Nat., n. s., vol. vii, p. 43, pl. iv, figs. 67—81.
— OBSCURA, *Reuss*, 1874. Palæontographica, vol. xx, pt. 2, p. 81, pl. xx, figs. 1—4.
DENTALINA DEMISSA, *Terquem and Berthelin*, 1875. Mém. Soc. Géol. France, ser. 2, vol. x, Mém. No. 3, p. 28, pl. ii (xii), figs. 10 *a—g*.
NODOSARIA RAPHANUS, *Blake*, 1876. Yorkshire Lias, p. 456, pl. xviii, figs. 14, 14*a*.
DENTALINA BURGUNDIÆ, *Idem*, 1876. Ibid., p. 461, pl. xviii, fig. 29.
NODOSARIA RADICULA, var. RAPHANUS, *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, No. 4, p. 20, pl. i, figs. 9, 10.
— RAPHANUS, *Terrigi*, 1883. Atti Accad. Pont. N. Linc, vol. xxxv, p. 172, pl. ii, fig. 5.
— — *Brady*, 1884. Report 'Challenger,' p. 512, pl. lxiv, figs. 6—10.
— — *Balkwill and Wright*, 1885. Trans. Roy. Irish Acad., vol. xxviii (Sci.), p. 342, pl. xii, fig. 26.
— — and var., *Sherborn and Chapman*, 1886. Journ. Roy. Microsc. Soc., ser. 2, vol. vi, p. 749, pl. xiv, figs. 36, 37.
— — *Brady*, 1887. Journ. Roy. Microsc. Soc. for 1887, p. 909.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 41.
— — *Idem*, 1890. Mem. Roy. Accad. Sci. Istit. Bologna, ser. 4, vol. x, p. 470, pl. o, figs. 24, 25.
— SCALARIS, *Haeusler*, 1890. Abhandl. Schweiz. Paläont. Ges., vol. xvii, p. 101, pl. xiii, fig. 91.
— MULTICOSTA, *Idem*, 1890. Ibid., p. 102, pl. xiii, fig. 92.
— RAPHANUS, *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 82, pl. ii, fig. 16.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 380.
— — *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, pp. 621 and 626, pl. v, figs. 56—59 (figs. 56, 57, and 58 are marginuline).

NODOSARIA RAPHANUS, *Fornasini*, 1894.		Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 204, 205, pl. i, figs. 41—45 (= *N. inflata* and *abbreviata*, Costa).
— —	*De Amicis*, 1895.	Nat. Sicil., Ann. xiv, pp. 29 and 61.

Characters.—Subcylindrical and tapering, varying from fusiform to club-shaped; longitudinally ribbed, the number and strength of the costæ variable.

Three varieties from the Crag are here illustrated:

1. Pl. I, figs. 4, 5; typical for such as Linné named from the figures given by Plancus and Gualtieri; with many ribs (15—16).

2. Pl. I, figs. 22, 23; short and thick, with few ribs (9—10). This form corresponds with fig. 86 of Silvestri's pl. iv, *Nodosaria acuticostata.*

3. Pl. VI, figs. 9, 10; short, thick, and neatly compact form (about 15 to 16 ribs). Fornasini's *Nod. Bassanii*, 'Mem. R. Accad. Sci. Bologna,' ser. 5, vol. iv, 1894, pp. 205, 206, pl. i, figs. 38—40, is near this variety, but has fewer ribs.[1]

Gradations and varieties of *N. raphanus* are shown under the name "*Dentalina propinqua*, Beissel," 1891, in the 'Abhandl. K. Preus. Geol. Landesanst.,' n. s., pt. iii, p. 35, pl. vii, figs. 14—27.

NOTE.—As it is almost impossible to sort all the figured specimens allied to *N. raphanus* and coming within its varietal range, the foregoing synonymy must be understood as indicating some of the best marked and most distinguishable of the forms.

(There are also marginuline forms of the same type, which will be noticed under *Marginulina.*)

Occurrence.—*Nodosaria raphanus* is rather common in the Mediterranean and Adriatic at depths ranging to 1100 fathoms. The tables appended to the 'Challenger' report record its presence in soundings from off Culebra Island, Danish West Indies (390 fathoms); and from a depth of 1375 fathoms near Juan Fernandez. Its geological range extends from the Lias. It has also been recorded from the Chalk of Bohemia, Westphalia, and Keady Hill, Ireland; from the London Clay (Eocene); the Miocene of Malaga, Vienna, and Muddy Creek, Victoria; and the Pliocene of Italy. In the Coralline Crag it has been met with at Sudbourne and Broom Hill, zone **d**; and at Sutton. It has also been found in the Norwich Crag (Thorpe).

[1] In F. Sellheim's "Beitrag zür Foraminiferen-Kenntniss der fränkischen Juraformation," Inaugural Dissertation, &c., Erlangen, 1893, the *Dentalina*, sp. aff. *lamellosa*, Torq., page 12 (of sep. copy), pl. o, fig. 3, seems near enough for *Nodosaria raphanus;* and *N. duodecim-costata*, fig. 2, is not far removed; fig. 4 might be *N. raphanistrum.*

3. NODOSARIA RAPHANISTRUM (*Linné*). Plate I, figs. 6—8.

Part I, 1866, page 50; and Appendices I and II, Tables, No. 37.

Additional Synonyms:

Orthocerata seu tubuli concamerati, recti, &c., *Soldani*, 1780. Sagg. Oritt., p. 106, pl. v, figs. m M, o O; and Testaceogr., vol. ii, 1798, Appendix, p. 141, pl. v, figs. m M, o O.

— in longum striata, subconica, &c., *Soldani*, 1791. Testac., vol. i, part 2, p. 91, pl. xciv, fig. Z (few ribs).

NODOSARIA BACILLUM, *Blainville*, 1825. Malacol. (plates 1827), pl. v, fig. 4.

— — *Cuvier*, 1836—1846. Regne anim., vol. ix (and x), p. 35, pl. xv, fig. 12.

— FILIFORMIS, *Henderson*, 1837. Cuvier's Animal Kingdom, vol. iii (plates), pl. viii, fig. 10.

— RAPHANISTRUM, *Reuss*, 1846. In Geinitz's Grundriss Verst., p. 653, pl. xxiv, fig. 6.

— COMPRESSIUSCULA, *Neugeboren*, 1852. Verh. Mitth. Siebenburg. Ver. Nat., vol. ii, p. 59, pl. i, figs. 54—56; vol. iii, p. 79.

— RAPHANISTRUM, *Bronn*, 1856. Lethæa Geogn., ed. 3, p. 241, pl. xxv 3, figs. 2 *a—d*.

— COMPRESSIUSCULA, *Neugeboren*, 1856. Denkschr. k. Akad. Wiss. Wien, vol. xii, p. 79, pl. ii, figs. 1—7.

— BACILLUM, *Costa*, 1857. Mem. Accad. Sci. Napoli, vol. ii, p. 134, pl. i, figs. 7 *a—c*.

— — *Bronn*, 1859. Klassen, &c., p. 72, pl. vi, figs. 14 *a—e*.

— — *Mackie*, 1859. Recreative Science, vol. i, p. 148, fig. 18.

— BADENENSIS (part), *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. xix, fig. 9.

— RAPHANUS, *Iidem*, 1860. Ibid., fig. 10.

— BACILLUM, *Suess*, 1862. Boden Stadt Wien, p. 45, fig. 1 1.

NODOSARINA (NODOSARIA) RAPHANISTRUM, *J. and P.*, 1864. Geologist, vol. vii, p. 88.

NODOSARIA RAPHANISTRUM, *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 50, pl. i, figs. 6—8.

— — *Brady*, 1867. Proc. Somerset Arch. Nat. Hist. Soc., vol. xiii, p. 222, pl. i, fig. 7.

NODOSARIA BACILLUM, *Gümbel*, 1870. Abhandl. k. Bayer. Akad. Wiss., vol. x, p. 618, pl. i, fig. 30. The following, also shown in the same plate, are either members or varieties of the same species:—*subalpina*, G., fig. 26; *pachycephala*, G., fig. 27; *eocæna*, G., fig. 28; *Helli*, G., fig. 29; *Maximilliana*, G., fig. 31; *latejugata*, G., fig. 32; *sceptriformis*, G., fig. 33.

— RAPHANISTRUM, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 156, pl. ix, fig. 41.

— — *Silvestri*, 1872. Accad. Giœnia Sci. Nat., n. s., vol. vii, p. 27, pl. i, figs. 1—19 (including young and small forms); and var. MONSTRUOSA, ibid., pl. i, figs. 20—25, and pl. ii, figs. 26—29 (chiefly the megalospheric or "A" form); and var. *coarctata*, pl. ii, figs. 30—47, and pl. iii, figs. 48—50 (locally constricted individuals).

— BACILLUM, *Schlumberger*, 1874. Compt. Rendu Assoc. France for 1872, p. 562, figs. 14, 15.

— RAPHANISTRUM, *Blake*, 1876. Yorkshire Lias, p. 457, pl. xviii, figs. 18, 18*a*.

— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 3.

— LATEJUGATA, *Hantken* (1875), 1881. Mitth. Jahrb. Ung. Geol. Anstalt, vol. iv, p. 26, pl. ii, figs. 6 *a—d*.

— BACILLOIDES, *Idem* (1875), 1881. Ibid., p. 27, pl. ii, fig. 8 (short).

— BACILLUM, var. MINOR, *Idem* (1875), 1881. Ibid., p. 26, pl. ii, fig. 7.

— BUDENSIS, *Idem* (1875), 1881. Ibid., p. 28, pl. ii, fig. 10.

— — *Jones*, 1876. M. Microsc. Journ., vol. xv, pl. cxxix, figs. 8 *a*, *b*.

— BACILLUM, *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, pl. viii, fig. 14.

— — *Schlumberger*, 1882. Feuil. Jeun. Nat., part 1, pl. i, fig. 5; and pl. ii, fig. 5.

— RAPHANISTRUM, *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 422, fig. 266, 8.

— — *Koenen*, 1885. Abhandl. k. Ges. Wiss. Göttingen, vol. xxxii, p. 110, pl. v, figs. 16—20.

— — *Quenstedt*, 1885. Handb. Petref., ed. 3, part 5, p. 1050, pl. lxxxvi, figs. 4, 5.

— AFFINIS, *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 748, pl. xiv, fig. 33.

— BACILLUM, *Iidem*, 1886. Ibid., p. 748, pl. xiv, fig. 34.

NODOSARIA RAPHANISTRUM, var., *Iidem*, 1886.		Ibid., p. 749, pl. xiv, fig. 38.
— POLYGONA, *Iidem*, 1886.		Ibid., p. 749, pl. xv, figs. 2—4.
— RAPHANISTRUM, *Fornasini*, 1886.		Boll. Soc. Geol. Ital., vol. v, pp. 146, 147, 148, 193, 194.
— —	*Haeusler*, 1890.	Abhandl. Schweiz. Pal. Ges., vol. xvii, p. 101, pl. xiii, figs. 82—85, 89, 96 (with few ribs; fragments and young).
— —	*Fornasini*, 1894.	Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 203 and 205, pl. i, figs. 50, 51 (= *N. deiscens* and *bacillum*, Costa).
— —	*De Amicis*, 1895.	Nat. Sicil., Ann. xiv, pp. 30 and 61.

Characters.—This, when in good condition, is the longest, straightest, and most symmetrical of the costate *Nodosariæ*. Shorter forms approach, and indeed pass into *N. raphanus*, becoming broader in some parts of the shell than in others. Many individuals commenced growth with a large primordial segment (*megalospheric* or form "A"—see above, p. 90); and others with a small beginning (*microspheric*, or form "B") have the shell tapering backwards or downwards to a point. These features, as well as irregularities of growth, have influenced the giving of names to a great extent. When the shell has grown with a curvature it becomes a *Dentalina;* when the excentricity brings the stolon more to one side than the other, the form becomes a *Vaginulina* or *Marginulina*, and when extreme leads to *Cristellaria*.[1]

Gradational varieties of *N. raphanistrum* are well shown under the name "*Dentalina acuta*, d'Orb.," and "*D. polyphragma*, Reuss," in 'Abhandl. K. Preuss. Geol. Landesanst.,' n. s., part iii, 1891, pp. 37, 38, pl. vii, figs. 28—65.

Occurrence.—*Nodosaria raphanistrum* is of very rare occurrence in recent seas. It has been found in the Mediterranean and Adriatic. Fossil specimens have been recorded from the Lias of Yorkshire and elsewhere, the Oxford and Kimmeridge Clays; and there are corresponding forms, such as *Nod. Zippei*, &c., in the Chalk of England, Westphalia, and Bohemia. *N. raphanistrum* is also known in the Eocene (London Clay and Thanet Sands[2]); the Miocene of Vienna, Italy, Malaga, Malta, and San Domingo; also in the Pliocene of Italy, and of Auckland, New Zealand. In the Coralline Crag it has been found at Sutton only.

[1] This subject has often been treated of; for instance, in the 'Monthly Microsc. Journ.,' vol. xv, 1876, p. 76.

[2] Mentioned in the 'Mem. Geol. Survey Gt. Brit.,' vol. iv, 1872, p. 575, but it is doubtful. The allocation of this species, together with a *Planorbulina* and a *Polymorphina*, to the Woolwich and Reading beds, at p. 578, is a mistake.

4. Nodosaria proxima, *Silvestri*, 1872. Plate IV, fig. 8 ("*N. scalaris*"); Plate VII, fig. 15.

Part I, 1866, page 52 (*N. scalaris*); and Append. I and II, Tables, No. 38.

Nodosaria Catesbyi, *d'Orb.*, 1839. Foram. Cuba, p. 16, pl. i, figs. 8—10.
— scalaris,[1] *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 52, pl. iv, fig. 8.
— (D.) crassa, *Hantken*, 1868. Magyar földt társ. munk., vol. iv, p. 86, pl. i, fig. 15.
— bacilloides, *Idem*, 1868. Ibid., p. 86, pl. i, figs. 9 *a—c*.
— proxima, *Silvestri*, 1872. Atti Accad. Giœnia Sci. Nat., n. s., vol. vii, p. 63, pl. vi, figs. 138—147.
— variabilis (?), *Terquem and Berthelin*, 1875. Mém. Soc. Géol. France, ser. 2, vol. x, Mém. No. 3, p. 20, pl. i (xi), figs. 19 *a—f*.
— crassa, *Hantken*, 1875 (1881). Mitth. Jahrb. K. Ungar, geol. Ges., vol. iv, p. 28, pl. xiii, fig. 4.
— bacilloides, *Idem*, 1875 (1881). Ibid., p. 27, pl. ii, fig. 8.
— proxima, *Brady*, 1884. Report "Challenger," p. 511, pl. lxiv, fig. 15.
— — *Fornasini*, 1888. Boll. Soc. Geol. Ital., vol. vii, p. 48, pl. iii, figs. 10, 11 (somewhat marginuline).
— mutabilis, *Crick and Sherb.*, 1891. Journ. Northampton Nat. Hist. Soc., vol. vi, p. 214, pl. vi, figs. 7, 8.
— proxima, *Terrigi*, 1891. Mem. Comitato Geol. Ital., vol. iv, p. 82, pl. ii, fig. 17.
— — *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 206, pl. i, figs. 33—35 (= *N. trilocularis*, Costa).

These two small Nodosarians from the Crag, bilocular and ribbed, having the suture well marked and a projecting mouth-piece, are nearly matched with either the small young or arrested forms of *Nodosaria longicauda*, d'Orb., in Silvestri's memoir referred to above, p. 58, pl. v, figs. 107, 108, and 118, and var., pl. vi, figs. 133, 134, or, with the small forms, figs. 138—147, which he has named *N. proxima*, p. 63. The latter are the nearest to ours, inasmuch as the second segment is smaller and more tapering than the first. The latter feature, namely, the delicate lagenoid second chamber, is emphasised in *N. pupoides*, Silv., p. 65, pl. vi, figs. 148—158. Indeed, all the three so-called "species" (*longicauda*, *proxima*,

[1] In the list of synonyms at pp. 52, 53, the names *Nodosaria inflata*, Reuss, *Dentalina inflata*, Reuss, and *Nodosaria nana*, Reuss, should not have been inserted as belonging to the real *N. scalaris*.

and *pupoides*) are essentially the same, differing but slightly in contour and style of growth. Of the three, the little specimens from the Crag best agree with the *proxima* form.

Pl. vii, fig. 15 (Gedgrave), has the sutures shallower and the riblets smaller than pl. iv, fig. 8 (Bridlington). Brady's figure of *N. proxima* has the two chambers nearly equal in size, with a deep suture, and he was somewhat inclined to refer it to *N. scalaris* (Batsch). The number of ribs varied in the specimens collected by the 'Challenger.'

Some bilocular costate *Lagenæ* (simulating *N. proxima*) have been figured by Parker and Jones, Wallich, O. Rymer Jones, &c.; they have the second or superadded chamber larger than the first, corresponding in some degree to the beginning of microspheric *Nodosariæ.*

Throughout the series from the Crag there is considerable variation in both the depth of suture and number of riblets.

Occurrence.—Nodosaria proxima in recent seas appears to be confined to tropical and subtropical latitudes. Specimens were obtained by the 'Challenger' from off the Azores (450 fathoms); off Tristan d'Acunha (100 to 150 fathoms), of Raine Island, Torres Strait (155 fathoms); off the Phillipines (95 fathoms), and off the coral reef of Honolulu (40 fathoms). The shell figured in 'Phil. Trans.,' vol. clv, 1865, pl. xvi, fig. 2, from the North Atlantic, under the name of *N. scalaris*, is probably referrible to this species.

Fossil specimens have been obtained from the Pliocene of San Quirico, near Sienna (Silvestri), and of Ponticello, near Bologna (Fornasini). We have in our own collections numerous specimens from the Miocene of Muddy Creek, and from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it occurs in nearly every zone examined.

Genus[1] 3.—Dentalina, *d'Orbigny*, 1826.

Part 1, 1866, p. 53.

This subgeneric (or, indeed, only *quasi*-subgeneric) form of *Nodosaria* has been so often referred to by writers on Foraminifera, both separately and under the name of *Nodosaria*, that it appears to be useless to endeavour to disentangle the reference further than as suggested at page 53 of Part I. So that besides indicating *Nodosarina* as having been used as a comprehensive generic term by Parker, Jones, Goës, and a few other authors, we need only add to each of the lists there given, under "Nodosaria" and "Dentalina," the words "and others."

[1] *Quasi*-generic only.

To do away with the term "*Dentalina*" would be very inconvenient, and, indeed, an unnecessary sacrifice to an attempted exactness in terminology; for its use is certainly convenient in the frequent mention and defining of the arcuate and tapering Nodosarians to which it has been so long applied, whether by itself, or inserted in brackets after "*Nodosaria*."

1. Dentalina obliqua (*Linné*), 1767. Plate I, fig. 9; Plate V, fig. 6.

Part I, 1866, p. 54; and Append. I and II, Tables, No. 42.

Additional Synonyms:

Orthoceras, *Martini*, 1769. N.'Syst. Conch.-Cab., vol. i, pp. i and 39, Vignettes, *H*, *h*.

Orthocerata *conico-cylindroidea*, recurva, striata, &c., *Soldani*, 1780. Saggio Orittographia, p. 107, pl. v, figs. 37 p P; Hortoceratia, &c., Testaceogr., vol. ii, Appendix, 1798, p. 141, pl. v, figs. 37 p P [an arcuate, tapering form of *N. raphanus*].

Orthoceratia in longum striata, subconica, &c., *Soldani*, 1791. Testaceogr., vol. i, part 2, p. 91, pl. xciv, fig. *S* (= *Nodosaria* [*Dentalina*] *substriata*, d'Orb. Ann. Sci. Nat., vol. vii, 1826, p. 255, No. 46; Ann. Mag. N. H., ser. 4, vol. viii, 1871, p. 160, No. 27, pl. ix, fig. 54.) A tapering form, with short chambers, imperfectly costate.

— *Baculi*, I, K, L, ostendunt aliquas *Raphani* vel *Raphanistri* varietates, *Soldani*, 1791. Ibid., p. 97, pl. ciii. [Fig. I (= *Nodosaria* [*Dentalina*] *Cuvieri*, d'Orb., vol. vii, 1826, p. 255, No. 45; Ann. Mag. N. Hist., ser. 4, vol. viii, 1871, p. 160, No. 26, pl. ix, fig. 57.] Curved, conico-cylindroid, tapering; except near the top the septa are not excavate. In fig. K the lower half is *D. obliqua*, but the upper part takes on smooth and short chambers, like those in *N. ambigua*. In fig. L the lower part is *D. obliqua*, but the upper and larger moiety has only short, scattered, irregular riblets.

Orthoceras *corniculum*, &c., *Soldani*, 1791. Ibid., p. 98, pl. ciii, fig. *k* (= *N.* [*D.*] *cornicula* [*um*], d'Orb.,[1] Ann. Sci. Nat., vol. vii, 1826, p. 255, No. 47; Ann. Mag. N. H., ser. 4, vol. viii, 1871, p. 161, No. 28, pl. ix, fig. 56). Strongly curved; thin at first, thicker with swollen chambers afterwards.

Orthoceratia filiformia aut capillaria, &c., *Soldani*, 1798. Testaceogr., vol. ii, p. 35, pl. x, figs. *f*, *g* (= *Nodosaria nodosa*, d'Orbigny, Ann. Sci. Nat., vol. vii, 1826, p. 254, No. 31; Ann. Mag. N. H., ser. 4, vol. viii, 1871, p. 158, No. 17, pl. ix, fig. 55; not *N. nodosa*, d'Orb., Mém. Soc. géol. France, vol. iv, part 1, 1840, p. 14, pl. i, figs. 6, 7). A long, slender, tapering form, with suboval chambers.

DENTALINA BIFURCATA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 162, pl. xii, fig. 27.

NODOSARIA MUTABILIS, *Costa*, 1856. Ibid., vol. vii, p. 150, pl. xiii, fig. 1.

— (DENTALINA) OBLIQUA, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist. ser. 3, vol. iii, p. 482.

— — — *P., J., and B.*, 1861. Ibid., ser. 3, vol. xvi, p. 19, pl. i, fig. 32.

DENTALINA OBLIQUA, *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 54, pl. i, fig. 9.

— — *Brady*, 1867. Proc. Somerset Arch. N. H. Soc., vol. xiii, p. 224, pl. i, fig. 17.

— RAPA, *Blake*, 1876. Yorkshire Lias, p. 460, pl. xix, fig. 3.

NODOSARIA OBLIQUA, *Brady*, 1884. Report 'Challenger,' p. 513, pl. lxiv, figs. 20—22.

— (DENTALINA) OBLIQUA, *Basset*, 1885. Ann. Soc. Sci. Charente-Inf. for 1884, p. 160.

DENTALINA MULTILINEATA (?), *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 751, pl. xv, fig. 14.

NODOSARIA OBLIQUA, *Brady*, 1887. Journ. R. Microsc. Soc. for 1887, p. 909.

— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 223, pl. xliv, fig. 7.

DENTALINA SULCATA, *Sherborn and Chapman*, 1889. Journ. R. Micr. Soc. for 1889, p. 486, pl. xi, fig. 24.

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[1] By changing *corniculum* into *cornicula* d'Orbigny made a *little crow* out of a *little horn*, which latter the shell resembles.

NODOSARIA OBLIQUA, *Fornasini*, 1892. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. ii, p. 564, pl. o, figs. 1—3 (forma A); figs. 4, 5 (forma B); fig. 6, var.? (forma A); fig. 7, var. *vertebralis*, Batsch (forma A). Ibid., vol. iii, 1893, p. 434, pl. ii, fig. 5; vol. iv, 1894, pp. 203, 204, 209, 213, pl. i, figs. 46—49; pl. ii, figs. 7—9 (*D.* and *N. mutabilis* and *N. siphunculoides*, Costa).

— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 387 (long synonymy).

— — *Dervieux*, 1894. Ibid., vol. xii, fasc. 4, p. 626, pl. v, fig. 62.

— VERTEBRALIS (?), *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 344, pl. xi, fig. 36.

— OBLIQUA, *Goës*, 1894. K. Vet.-Akad. Handl., vol. xxv, No. 9, p. 70, pl. xii, figs. 691—696.

Characters.—This is an elongate, acuminate, and arcuate modification of *Nodosaria raphanus*, and to avoid repetitive terminology the word *Nodosaria* is here omitted before *Dentalina*, as intimated above at pages 206 and 220. This is not the smooth *D. obliqua* of d'Orbigny; see 'Ann. Mag. Nat. Hist.,' 1871, p. 159.

The slender, acuminate, and straight (microspheric) form of *N. raphanus* (*N. aciculata* of Lamarck) is beautifully illustrated by Silvestri ('Atti Accad. Giœnia Sci. Nat.,' ser. 3, vol. vii, 1872, p. 39, pl. iii, figs. 52—56) as *Nodosaria conica* (thus named by him after Soldani, but not by the latter, for Soldani named nothing according to the Linnæan method).[1]

Occurrence.—*Dentalina obliqua* has a wide geographical and bathymetrical range. The tables appended to the 'Challenger' Report record the occurrence of specimens at six stations, namely, off the north-west coast of Ireland, off the west coast of Africa, off the Cape of Good Hope, between Prince Edward Island and Kerguelen, off Sydney, and in the equatorial region of the South Pacific. The depth in these cases ranged from 150 to 2425 fathoms. It occurs also in the Mediterranean and Adriatic. Fossil specimens have been recorded from the Permian (*D. Kingii*), from the Lower Lias (Brady), from the Chalk of Bohemia and of Swanscombe (Kent), from the London Clay (Eocene), the Oligocene of Elsass, the Miocene of Italy, Messina (Sicily), and Muddy Creek (Victoria), from the Pliocene of Italy, and of Garrucha, South Spain. In addition to the record from Sutton given in the First Part of this Monograph, we have specimens from Sutton, zone f, and from Aldborough, zone g.

[1] See 'Ann. Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 153.

2. Dentalina obliquestriata, *Reuss*. Plate I, fig. 19.

Part I, 1886, p. 56; and Appendices I and II, Tables, No. 40.

Additional Synonyms:[1]

Orthocerata, seu tubuli concamerati, recti, striati, *Soldani*, 1780. Sagg. Oritt., p. 106, pl. v, fig. 37 *N* (?).
Dentalina obliquestriata, *Bronn*, 1856. Lethæa Geogn., ed. 3, vol. iii, p. 240, pl. 35 $_2$, fig. 1.
Nodosaria obliquestriata, *Costa*, 1857. Mem. Accad. Sci. Napoli, vol. ii, pl. i, fig. 24.
Dentalina obliquestriata, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 56, pl. i, fig. 19.
— — *Blake*, 1876. Yorkshire Lias, p. 460, pl. xix, fig. 4.
Marginulina Bononiensis (?), *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 187, pl. ii, fig. 7 *a*, *b*.
Dentalina obliquestriata, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 751, pl. xv, fig. 15.

Characters.—Tapering and bent; many oblique riblets on each chamber, excepting sometimes the latest.

Occurrence.—Dentalina obliquestriata, as stated in the First Part of this Monograph, appears not to have been found in a recent condition. No mention of it is made by Brady in the 'Challenger' Report. It has been recorded from the Yorkshire Lias (Tate and Blake); from the London Clay (Sherborn and Chapman); and we have it from the Casterlian of the Kattendyk Docks, Antwerp. So far as the Crag is concerned, we have nothing to add to the record in the First Part of the Monograph.

3. Dentalina pauperata, *d'Orbigny*, 1846. Plate I, figs. 13—18 and 20.

Part I, 1866, pages 59 and 63; and Appendices I and II, Tables, No. 39.

In the First Part of this Monograph, d'Orbigny's *Dentalina pauperata* was taken as a subtypical form to which certain Dentalines might be conveniently referred. Their relationship one to another, and to *D. communis*, d'Orb., was carefully indicated in the nomenclatorial lists at pages 58—62. Names upon names have been given for this kind of smooth, arcuate, tapering, and very

[1] Signor C. Fornasini ('Boll. Soc. Geol. Ital.,' ix, 1890, pp. 345–6) points out that in the synonyms "*D. Geintziana*, Terquem," should be changed to "*D. matutina*, Terquem;" and "pl. ii" should be inserted.

variable shell; and it scarcely appears worth while to enlarge the synonymy. Many plates in the works of d'Orbigny, Reuss, Schlicht, Terquem, Neugeboren, Goës, Dervieux, Egger, Beissel, and others, contain legions of named specimens showing modifications of this simple type.

As some of the later illustrations of *Dentalina pauperata* itself, the following may be mentioned.

DENTALINA COMMUNIS (part), *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 59, pl. i, figs. 13—18, 20.
— PAUPERATA, *Brady*, 1867. Proceed. Somerset Arch. N. H. Soc., vol. xiii, p. 224, pl. i, fig. 14.
— — *Hantken*, 1876 (1881). Magyar kir. földt. int. évkönyve, p. 26, pl. iii, fig. 6; Mitth. Jahrb. Ungar. geol. Anstalt, vol. iv, p. 31, pl. iii, fig. 6.
— — *Blake*, 1876. Yorkshire Lias, p. 458, pl. xviii, fig. 23.
— — *Terrigi*, 1883. Atti Accad. Pont. Nuovi Lincei, vol. xxxv, p. 178, pl. ii, fig. 14.
NODOSARIA (DENTALINA) PAUPERATA, *Brady*, 1884. Report 'Challenger,' p. 500, cuts, figs. 14 *a, b, c*.
DENTALINA PAUPERATA, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 750, pl. xv, fig. 9.
NODOSARIA ANNULATA, *Fornasini*, 1889. Foram. Mioc. S. Rufillo, pl. i, figs. 10—13.
DENTALINA INCRASSATA, *Beissel* (*Holzapfel*), 1891. Abhandl. k. Preuss. Geol. Landesanst., n. s., part 3, p. 35, pl. vii, figs. 10—13.
NODOSARIA PARONÆ, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, p. 611, pl. v, figs. 36, 37.
— PAUPERATA, *Idem*, 1894. Ibid., p. 612, pl. v, fig. 38.
— — var. ELONGATA, *Idem*, 1894. Ibid., fig. 39.
— CAMERANI, *Idem*, 1894. Ibid., figs. 40, 41.
— GLOBULOSA, *Idem*, 1894. Ibid., p. 614, pl. v, fig. 44.
— APPROXIMATA, *Idem*, 1894. Ibid., figs. 45, 46.
— PAUPERATA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 68, pl. xii, figs. 672—688.

It may be mentioned that in Soldani's Testaceogr., vol. i, part 2, 1791, p. 98, pl. cv, fig. *M*, referred to by him as "Orthoceras *Cuspis*," is the same as *D. pauperata*, or a sub-variety of *D. farcimen*, Reuss.

Characters.—Often irregular in growth, the chambers not being symmetrical in shape and size; the early chambers are generally subcylindrical and compact; sometimes the septa are nearly all obscure.

Occurrence.—The typical form, namely, *Dentalina communis*,[1] d'Orb., is found

[1] In 1863 von Reuss ('Bull. Acad. Roy. Belge,' ser. 2, vol. xv, p. 146, pl. i, fig. 18) separated the variety "with straight septal planes" (part 1, 1866, p. 58) from that "with oblique septa,"

in nearly all seas, and at all depths from the shore-line down to 2740 fathoms. It is worthy of note that the distribution tables appended to the 'Challenger' Report record no specimens from the North Pacific.

The shell has been found in a fossil condition in the Carboniferous and Permian Limestones; in the Yorkshire Lias; in the Cretaceous formations generally; in the London Clay (Eocene); in the Miocene of Vienna, Italy, and Malaga; in the Pliocene of Garrucha (South Spain), Italy, and Kar Nicobar; and in Pleistocene deposits generally.

The tables appended to the 'Challenger' Report show a rather restricted geographical range for *Dentalina pauperata*. The records of its occurrence are almost entirely from high latitudes, and from depths ranging from 13 to 245 fathoms. Its earliest recorded occurrence in a fossil condition is from the Lias (Terquem). It has also been found in the Gault of Folkestone; the Upper Chalk of Taplow, Bucks, and Keady Hill, Ireland; the London Clay (Eocene); the Miocene of Piedmont, Vienna, and Muddy Creek, Victoria; and the Pliocene of Piedmont and St. Erth. In the Coralline Crag it has been found at Sutton only.

Genus 4.—Vaginulina, *d'Orbigny*, 1826.

Part I, 1866, page 63.

Brady, Report 'Challenger,' 1884, *p.* 529.

Additional Synonyms:

Cornu Hammonis, *Plancus.*
Orthoceratia, *Soldani.*
Planularia, *Defrance, Cornuel.*
Vaginulina, *Michelotti, Philippi, Costa, Gümbel, Deecke, Fornasini, Dervieux, Goës, Egger, Zwingli and Kübler, Berthelin, Neugeboren, Quenstedt, Koch, Hagenow, Chapman, &c.*
Citharina, *d'Orbigny, Reuss, Costa, Schwager.*
Marginulina, *Reuss, Terquem.*
Dentalina, *Williamson, Parker and Jones.*
Nodosaria, *Reuss.*

D. communis (p. 61), under the name *D. farcimen*, after Soldani's "Orthoc. *Farcimen*," 'Testaceogr.,' vol. i, part 2, 1791, p. 98, pl. cv, fig. o. A closely allied variety is Soldani's "*Corniculum læve*," ibid., p. 92, pl. xcvii, fig. *bb*. As Soldani did not use the Linnæan method of nomenclature, the straight-sutured *Dentalina* is really "*D. farcimen* of Reuss." Further, Soldani applied the term "farcimen" to more than one of his figured specimens (see 'Annals Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 154, No. 2; and p. 159, No. 20; also ibid., p. 153): if individual names were taken for species from his books (and there they seem sometimes to have been used as much generically a otherwise) much confusion would arise in the alteration of numerous trivial names.

General Characters.—*Vaginulina* is an elongate, more or less compressed or complanate Nodosarine, with eccentric (marginal) aperture and oblique chambers; straight or curved; septate or compact; smooth, limbate, or costate.

Linné adopted the figures published by Plancus, Gualtieri, and Ledermüller for his *Nautilus legumen*.[1] The figure given by Gualtieri is decidedly limbate; but those by Plancus and Ledermüller, although apparently limbate, may be smooth (as regarded by Signor Fornasini), with the septa marked only by a difference in the shell-structure, as more clearly shown in Brady's figures in the 'Challenger' Report. Doubtless both the limbate and the smooth forms come together under the same species zoologically, but their readily distinguished features make it convenient to retain distinct names for them. Their relationship was indicated in the tabular list at pages 64—66 in Part I; the smooth forms being variety α, var. β, and var. η; the limbate forms (*V. legumen* proper) being comprised in varieties γ, δ, ϵ, ζ, θ, ι, κ.

The trivial circumstance of the *quasi*-smooth figure given by Plancus being the first mentioned by Linné in his references (possibly because his was the oldest book) does not keep us from accepting the *limbate* form (Gualtieri's) as this best medium type (according to the plan followed by Parker and Jones), around which the weak and smooth (*V. lævigata*, &c.) on one hand, and the more ornamented forms (*V. linearis*, &c.) on the other, are taken as noticeable varieties; as in the classificatory lists above referred to.

This species (including the forms figured by Plancus and Gaultieri) is referred to by Parker and Jones in the 'Annals Mag. Nat. Hist.,' ser. 3, vol. iii, 1859, p. 479. See also C. Fornasini's remarks on the limbate form in the 'Bollet. Soc. Geol. Ital.,' vol. v, pp. 25—30, with woodcut copies of the early figures published by Plancus, Gaultieri, and Ledermüller.

1. VAGINULINA LÆVIGATA, *Roemer*, 1838. Plate IV, fig. 9; Pl. V, fig. 8.

Part I, 1866, pp. 65, 66; and Append. I and II, Tables, No. 44 (Bridlington).

Additional Synonyms:

Orthocerata vaginulam gladii referentia, *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. 44 *m M*; Testaceogr., vol. ii, 1798, p. 141.

[1] 'Syst. Nat.,' edit. x, vol. i, 1758, p. 711, No. 248.

Nautilus legumen, Plancus, Conch. [1739], p. 16, pl. i, fig. 7; Gualtieri, Index [1742], pl. xix, fig. P.

'Syst. Nat.,' edit. xii, vol. i, part 2, 1767, p. 1164, No. 288.

Nautilus legumen, Plancus and Gualtieri, as above; Ledermüller, Micr. [1760, p. 17; 1761, p. 18], pl. viii, fig. *g*.

Orthoceratia lævia subconica, &c., *Soldani*, 1791. Testaceogr., vol. i, part 2, p. 92, pl. xcvii, figs. *e e*, *f f* [*e e*, chambers discrete, smooth; *f f*, chambers compact, smooth].

— Lituata, &c., *Idem*. Ibid., p. 95, pl. c, figs. *b b ?*, *c c* [*b b*, *Dentalina ?*, curved, chambers discrete, smooth; *c c*, *Vaginulina*, chambers discrete, smooth].

Orthoceras *Cuneus*, *Idem*. Ibid., p. 98, pl. cv, figs. *T*, *V* [*T*, edge-view, compact and smooth; *V*, not quite compact, smooth].

Vaginulina lævigata, *Roemer*, 1838. Neues Jahrb. f. Min. for 1838, p. 383, pl. iii, fig. 11.

— — *Michelotti*, 1841. Mem. Fisica Soc. Ital., vol. xxii, p. 278, pl. i, fig. 11.

— — *Reuss*, 1846. In Geinitz's Grundriss, &c., p. 657, pl. xxiv, fig. 12.

— Badenensis, *d'Orb.*, 1846. For. foss. Vienne, p. 65, pl. iii, figs. 6—8.

— lævigata, *Reuss*, 1856. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 226, pl. i, fig. 9.

— Beyrichi, *Idem*, 1856. Ibid., fig. 10 (*Marginulina*, at p. 226).

— lævigata, *Costa*, 1856. Atti Accad. Pontan., vol. vii, part 2, pl. xvi, fig. 16.

— legumen, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, pp. 453 and 457, pl. xix, figs. [26 ?], 27, 28.

— — var. *β*, *J.*, *P.*, *and B.*, 1866. Monogr. Foram. Crag, p. 65.

— lævigata, *J.*, *P.*, *and B.*, 1866. Ibid., p. 66, pl. iv, fig. 9.

— legumen, *Brady*, 1867. Proc. Somer. Arch. N. H. Soc., vol. xiii, p. 224, pl. i, fig. 18.

— lævigata, *Idem*, 1867. Ibid., vol. xiii, p. 225, pl. i, fig. 19.

— legumen, *Blake*, 1876. Yorkshire Lias, p. 464, pl. xix, fig. 11.

— — *Morris*, 1876. Lecture, Geol., Croydon, p. 8, fig. 3 *b*.

— — var. lævigata, *Jones*, 1884. Quart. Journ. Geol. Soc., vol. xl, p. 769, pl. xxxiv, fig. 5.

— — *Brady*, 1884. Report 'Challenger,' p. 530, pl. lxvi, figs. 13—15.

— — var. arquata, *Brady*, 1884. Ibid., p. 531, pl. cxiv, fig. 13.

— — var., *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 753, pl. xv, figs. 19 *a*, *b*.

— — *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Micr. Soc., p. 559, pl. x, fig. 16.

— — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 94, pl. iii, fig. 6.

— lævigata, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 65, pl. xi, figs. 646—655.

— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 37 and 62.

VAGINULINA LEGUMEN, *Egger*, 1895. Jahresb. Nat. Ver. Passau, vol. xvi, p. 24, pl. ii, figs. 4 *a*, *b*, 8.

Characters.—Straight or curved; chambers more or less compact, smooth. The Bridlington specimen (Pl. IV, fig. 9) is retained here for comparison with the Crag specimen (Pl. V, fig. 8). The former (megalospheric) is straight, compressed, and symmetrical; the latter (microspheric?) is curved and tapering; it is of irregular growth in the later chambers, which are not uniform or compact.

Occurrence.—This, together with the limbate and costate forms, is widely distributed in shallow and deep seas. It occurs fossil, with other *Nodosariinæ*, in the Lias, and many later formations of Secondary, Tertiary, and Post-Tertiary ages.

2. VAGINULINA LINARIS (*Montagu*), 1808. Plate I, figs. 10—12; and Plate V, fig. 7.

Part I, 1866, pages 66, 67; and Appendices I and II, Tables, No. 43.

Additional Synonyms:

MARGINULINA VAGINELLA, *Reuss*, 1851. Zeitsch. D. G. Ges., vol. iii, p. 152, pl. viii, fig. 2.

VAGINULINA STRIATA, *Costa*, 1856. Atti Accad. Linc. Pontan., vol. vii, p. 182, pl. xvi, fig. 17.

NODOSARIA (VAGINULINA) LEGUMEN, var. LINEARIS, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iv, pp. 346 and 351.

VAGINULINA LEGUMEN, var. ζ, *P., J., and B.*, 1866. Monogr. Foram. Crag, p. 66 (add fig. 48 to the reference to Williamson's figures).

— LINEARIS, *Iidem*, 1866. Ibid., p. 67, pl. i, figs. 10—12.

— — *Seguenza*, 1880. Atti R. Accad. Linc., ser. 3, vol. vi, p. 90, No. 247; p. 140, No. 636.

MARGINULINA BONONIENSIS (?), *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 187, pl. ii, fig. 7 *e*, *f*.

VAGINULINA LINEARIS, *Brady*, 1884. Report 'Challenger,' p. 532, pl. lxvii, figs. 10—12.

— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 115.

— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv No. 9, p. 66, pl. xii, fig. 664.

— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 38 and 62.

Characters.—The shell is subcylindrical or compressed; somewhat tapering, straight or bent; chambers more or less compactly set on. The surface-ornament

of longitudinal costulæ is variable in expression and extent, frequently not affecting the youngest chambers, and sometimes limited to the earliest, and partially affecting the tops of the other chambers near to or just below the junction with the next segment. This kind of ornament is present in several *Dentalinæ*, such as *D. Sandbergeri*, *D. Girardana*, and *D. intermittens*, Reuss, 'Sitz. k. Akad. Wiss. Wien,' vol. xviii, 1856, p. 224, pl. i, figs. 5, 6, 7; and *D. proteus*, Reuss, ibid., vol. xliv, 1861, p. 306, pl. i, figs. 6—9.

Note. — *Vaginulina striata*, d'Orb., after Soldani, is much compressed, symmetrically tapering, longitudinally costulate, compact, and rigid in its style of growth; and was taken as the type of *V. legumen*, var. θ (Part I, p. 66). As this form has been included by some in *Vag. linearis*, its synonymy is here appended.

Hortoceratia *vaginulam gladii referentia*, &c., Testa levissime in longum striata, *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, figs. 44 *n N*.

— seu tubuli concamerati, recti, striati, &c., *Idem*, 1798. Testaceogr., vol. ii, Appendix, p. 141, pl. vi, figs. 44 *n N*.

Vaginulina striata, *d'Orbigny*, 1827. Ann. Sci. Nat., vol. vii, p. 257, No. 3.

— — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 21.

— — *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, p. 161.

— — *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 178.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 151, No. 39.

— striatissima, *Schrodt*, 1890. Zeitsch. Deutsch. Geol. Ges., vol. xlii, p. 412, pl. xxi, figs. 9 *a*, *b*.

Occurrence.—*Vaginulina linearis* is a shallow-water form, rather commonly met with off the British coasts, and apparently most at home in the waters of the North Temperate Zone. Specimens were obtained by the 'Challenger' from three stations:—Off Bermuda (435 fathoms), off Culebra Island (390 fathoms), and south-east of Pernambuco (350 fathoms). In a fossil condition it has been found in the London Clay (Eocene); Tertiary of Upper Silesia; the Miocene of Italy, and Muddy Creek (Victoria); and in the Pliocene of Italy.

So far as the Crag is concerned, we have nothing to add to the record from Sutton in the First Part of the Monograph.

3. VAGINULINA OBLIQUESTRIATA, sp. nov. Plate V, figs. 9, 10, 11.

Characters.—This *Vaginulina* is stout, subcylindrical, varying from straight to arcuate: fig. 11 is the straightest; fig. 9 has a gentle curve; and fig. 10 tapers and bends like a *Dentalina*. The chambers are closely set, marked off by very slightly oblique septa. The surface-ornament consists of rather strong, oblique, longitudinal costulæ, either extending the whole length of the shell (fig. 9), or interrupted at the sutures (figs. 10 and 11). These riblets are most oblique in fig. 10, less so in fig. 9, and are almost straight in fig. 11.

Although compact and ribbed this form is not so much compressed as the flat *V. striata*, d'Orb. (after Soldani), which is the type of var. *θ* at page 66 of Part I, and it seems to require a distinct name.

A somewhat similar, but much stronger ornament is observable in the *Dentalina divergens*, Reuss, 1864 ('Sitz. k. Akad. Wiss. Wien,' vol. l, p. 456, pl. iv, fig. 10), with its strong oblique interrupted costulæ.

Of the various published *Vaginulinæ* related to *V. linearis* the following have oblique striæ.

1858. *Williamson*, 'Rec. Brit. For.,' pl. ii, figs. 46, 47 (*Dentalina legumen*, var. *linearis*).
1866. *J., P., and B.*, 'Monogr. For. Crag,' pl. i, fig. 10 (*Vaginulina linearis*).
1882. *Goës*, K. Sv. Vet.-Ak. Handl., vol. xix, No. 4, pl. ii, fig. 33 (*Nodosarina legumen*, var. *linearis*).
1884. *Brady*, Report 'Challenger,' pl. lxvii, figs. 10, 11 (*Vaginulina linearis*).

Occurrence.—The figured specimens are in the Searles-Wood Collection, from Sutton, in the British Museum.

Genus 5.—RHABDOGONIUM, *Reuss*, 1860.

Brady, Report 'Challenger,' 1884, *pp.* 70 *and* 524.

Synonyms:

VAGINULINA.—*d'Orbigny, Parker, Jones, and Brady.*
ORTHOCERINA.—*d'Orbigny, Carpenter, Blake, Bütschli.*
TRIPLASIA.—*Reuss, Costa.*
RHABDOGONIUM.—*Reuss, Karrer, von Gümbel, von Hantken, Terquem, Schwager, Brady, Berthelin, Quenstedt, and others.*

A Nodosarian test, straight, or slightly curved, angular or subcarinate; usually tri- or quadrangular in transverse section: chambers somewhat oblique or arched.

1. Rhabdogonium tricarinatum (*d'Orbigny*), 1826. Plate VII, figs. 16 *a*, *b*.

Vaginulina tricarinata, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 258, No. 4; Modèle, No. 4.
Rhabdogonium pyramidale, *Karrer*, 1861. Sitzungsb. k. Akad. Wiss. Wien, vol. xvi, p. 444, pl. i, fig. 5.
Vaginulina tricarinata, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 19, No. 41, pl. i, fig. 34.
Orthocerina rhomboidalis, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii, fig. 30.
Rhabdogonium pyramidale, *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 5.
— tricarinatum, *Brady*, 1884. Report 'Challenger,' p. 525, pl. lxvii, figs. 1—3.
— — [?], *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci), p. 344, pl. xii, figs. 17, 18.
— — *Sherborn and Chapman*, 1886. Journ R. Micr. Soc., ser. 2, vol. vi, p. 752 pl. xv, figs. 16 *a*, *b*.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 223, pl. xlv, fig. 3.
— — *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Microsc. Soc., p. 558, pl. x, figs. 7 *a*, *b*.
— — (?), *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 106.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 355, pl. xi, figs. 49, 50; pl. xii, figs. 36—38.
— — var. acutangulum, *Chapman*, 1894. Journ. R. Microsc. Soc. for 1894, p. 159, pl. iv, figs. 8 *a*, *b*.
— — *Egger*, 1895. Jahresb. Natur. Ver. Passau, vol. xvi, p. 23, pl. ii, figs. 18 *a*, *b*, 19.

Characters.—Shell three-cornered, varying to quadrangular, tapering; curved or twisted; chambers compactly set on; aperture central, with or without a short neck.

Occurrence.—*Rhabdogonium tricarinatum* has a wide geographical and bathymetrical range, but is most common in the North Atlantic, and has not apparently been yet met with in the North Pacific. It is most common in comparatively shallow

water, but has been found at a depth of 1360 fathoms. D'Orbigny's type specimens were from the Adriatic, and the shell has been found recently in the Mediterranean (Brady). Geographically *Rh. tricarinatum* extends to the Gault of Folkestone; specimens have also been found in the Red Chalk of Speeton, in the London Clay (Eocene), in the Miocene of Malaga and Vienna, in the Pliocene of Italy and Garrucha (South Spain); and we have specimens in our own collections from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have found it plentifully in every zone examined.

Genus 6.—Marginulina, *d'Orbigny*, 1827.

Part I, 1866, p. 68.

Brady, Report 'Challenger,' 1884, *pp.* 90 *and* 526.

Additional Synonyms:

Marginulina.—*Andreae, Stache, Philippi, Bailey, Hantken, Gümbel, Fornasini, Berthelin, Czjzek, Schwager, Sherborn, Chapman, Ehrenberg, Dunikowski, Mariani, Blake, Deecke, Toutkowski, Zwingli, Kübler, Brown, Vanden Broeck, Basset, Balkwill and Wright, Mangin, Seguenza, Terrigi, Egger, Goës, Bronn, Greene, Hartwig, Nicholson, Moberg, M. Sars, Beudant, Franzenau, Rzehak, Mackie, Prestwich, Williamson, Schlicht, Ansted, and others.*

General Characters.—Test elongate, straight or curved, with a partially spiral commencement; subcircular or suboval in section; aperture marginal; shell smooth or ornamented.

1. Marginulina glabra, *d'Orbigny*, 1826. Plate I, fig. 26.

Part I, 1866, page 69; and Append. I and II, Tables, No. 45.

Additional Synonyms:

Marginulina elongata, *d'Orb.*, 1840. Mém. Soc. Géol. France, vol. iv, p. 17, pl. i, figs. 20—22.

— pediformis, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 326, pl. xiii, fig. 13.

— contracta, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 186, pl. xiii, fig. 10.

Marginulina abbreviata, *Karrer*, 1861. Sitzungsb. k. Akad. Wiss. Wien, vol. xliv, p. 445, pl. i, fig. 7.
— inæqualis, *Reuss*, 1862. Ibid., vol. xlvi, p. 59, pl. v, fig. 13; pl. vi, fig. 8.
— infarcta, *Reuss*, 1863. Ibid., vol. xlviii, p. 48, pl. iii, figs. 36, 37.
— opaca, *Stache*, 1864. Novara-Exped. Geol. Theil., vol. i, part 2, p. 214, pl. xxii, fig. 47.
— angistoma, *Idem*, 1864. Ibid., p. 213, pl. xxii, fig. 46.
— mucronulata, *Idem*, 1864. Ibid., p. 215, pl. xxii, fig. 48.
— glabra, *Parker, Jones, and Brady*, 1865. Ann. Mag. N. H., ser. 3, vol. xvi, p. 27, pl. i, fig. 36.
— — *Brady*, 1868. Proc. Somers. Arch. N. H. Soc., vol. xiii, p. 225, pl. ii, fig. 22.
— — *Brady and Robertson*, 1870. Ann. Mag. N. H., ser. 4, vol. viii, Table, p. 360.
— subbullata, *Hantken*, 1875 (1881). Mitth. Jahrb. Ungar. Geol. Anstalt. vol. iv, p. 46, pl. iv, figs. 9, 10; pl. v, fig. 9.
— splendens, *Idem*, 1875. Ibid., p. 87, pl. iv, fig. 11.
— pediformis, *Idem*, 1875. Ibid., p. 45, pl. iv, figs. 12, 13; and pl. v, fig. 8.
Cristellaria articulata, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 140, pl. xiii, figs. 10, 10 *a*.
— trunculata, *Berthelin*, 1880. Mém. Soc. Géol. France, ser. 3, vol. i; Mém. v, p. 53, pl. iii, figs. 26, 27.
Marginulina glabra, *Brady*, 1884. Report 'Challenger,' p. 527, pl. lxv, figs. 5, 6.
— bullata, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 752, pl. xv, fig. 17.
— glabra, *Fornasini*, 1890. Mem. R. Accad. Sci. Bologna, ser. 4, vol. x, p. 470, plate, figs. 26, 28—30.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 346, pl. xi, figs. 28, 29.
Vaginulina [Marginulina] glabra, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xx, No. 9, pp. 65, 66, pl. xi, figs. 656—661.

Very numerous specimens of small Cristellarian and Marginuline passage-forms have been abundantly figured in various plates by d'Orbigny, Reuss, Schlicht, Terquem, Goës, and others. To collate and co-ordinate these exactly would be almost impossible. The foregoing synonomy, and that given by Signor G. A. De Amicis in the 'Bolletino Soc. Geol. Italiana,' vol. xii, fasc. 3, 1893, pp. 107, 108, will assist the student in this matter.

Characters.—A short, curved, partially spiral Nodosarine; with smooth, more or less inflated chambers, not numerous, and enlarging rapidly in process of growth. This little shell, which is very variable in its contours, feebly represents the far more compact and symmetrical *Cristellariæ.*

Occurrence.—*Marginulina glabra* has a wide geographical distribution, but apparently has not been met with in high latitudes. Specimens have been taken from depths ranging from 15 to 2740 fathoms. The geological range of the species is extensive. Specimens have been found in the Lias of England and the Continent; in the Cretaceous formations generally, both English and foreign; in the London Clay (Eocene), in the Oligocene of Germany, in the Miocene of Italy and Vienna; and in the Pliocene of Piedmont and Garrucha (South Spain). So far as the Crag is concerned, we have nothing to add to the record in Part I of the Monograph.

2. Marginulina costata (*Batsch*), 1791. Plate I, fig. 21. (*M. raphanus.*)

Part I, 1866, page 70 (*Marginulina raphanus*); Append. I and II, Tables, No. 46.

Additional synonyms:

Orthoceratia in longum striata, subconica, &c., *Soldani*,[1] 1791. Testaceogr., vol. i, part 2, p. 91, pl. xciv, figs. P, Q, X, Y.
Orthoceras *Sublituus*, testa teres, striata, &c., *Soldani*, 1791. Ibid., p. 98, pl. civ, figs. F, G [= *Marginulina sublituus*, d'Orb.].
Nautilus (Orthoceras) costatus, *Batsch*, 1791. Conchyl. Seesandes, p. 2, pl. i, figs. 1 *a*—*g*.
Marginulina sublituus, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 259, No. 9.
— raphanus, *Deshayes*, 1830. Hist. Nat. Vers, vol. ii, p. 418.
— — *Ehrenberg*, 1838. Abhandl. k. Akad. Wiss. Berlin for 1838, p. 141, pl. i, fig. 2.
— — *Cuvier*, 1836-46. Regne Animal, vol. ix, p. 35; vol. x, pl. xv, fig. 10.
— — *Michelotti*, 1841. Mem. Soc. Ital. Sci., vol. xxii, p. 279.

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[1] Soldani suggests that some of the specimens figured as "M, N, &c.," [M—Z?] in plate xciv might be such as with Linnæus would be termed "*Raphani*, *Raphanistri*, et *Rapistri*." Soldani thinks that figs. P, Q, and even Y may be varieties of his "Orthoceras *Corniculum*." The nominal references in 'Ann. Mag. Nat. Hist.,' September, 1871, p. 163, and in the 'Challenger' Report, p. 528, for "N, P, Q, R, X, Y," are not quite correct. M, N, R, and V belong to *Nodosaria raphanus*; S to *D. obliqua*; T and Z to *N. raphanistrum*.

MARGINULINA RAPHANUS, *Reuss*, 1846. In Geinitz's Grundriss Verstein, p. 656, pl. xxiv, fig. 15.

— — *Bronn*, 1851—6. Leth. Geogn., edit 3, vol. iii, p. 238, pl. xxxv^2, figs. 37 *a*, *b*.

— INTERAMNIÆ, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 184, pl. xiii, fig. 9.

NODOSARIA EXCENTRICA, *Costa*, 1857. Mem. Accad. Sci. Napoli, vol. ii, p. 137, pl. i, fig. 21.

— SUBLITUUS, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, pl. xx, fig. 37.

MARGINULINA OBLIQUESTRIATA, *Karrer*, 1861. Sitz. k. Akad. Wiss. Wien, vol. xliv, p. 446, pl. i, fig. 8.

— STRIATOCOSTATA, *Reuss*, 1862. Ibid., vol. xlvi, p. 62, pl. vi, fig. 2.

— TURGIDA, *Idem*, 1862. Ibid., p. 63, pl. vi, fig. 7.

NODOSARIA RAPHANUS, marginuline form, *Parker and Jones*, 1863. Ann. Mag. N. H., ser. 3, vol. xii, p. 213.

MARGINULINA RAPHANUS, *P. J. and B.*, 1865. Ibid., vol. xvi, p. 19, pl. i, fig. 35.

— — *Hartwig*, 1866. The Sea, edit. 3, p. 381, fig. *b*.

— — *J. P. and B.*, 1866. Monogr. Foram. Crag, p. 70, pl. i, fig. 21

— HAMUS, *Terquem*, 1866. Foram. Lias, 6me Mém., p. 501, pl. xxi, figs. 8 *a*, *b*.

— RADIATA, *Idem*. Ibid., p. 505, pl. xxi, figs. 16, 17.

— RAPHANUS, *Brady*, 1867. Proc. Somerset Arch. N. H. Soc., vol. xiii, p. 225, pl. ii, fig. 21.

— — *P. J. and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, pp. 163, 164, pl. x, figs. 72, 73.

— — (?), *Greene*, 1871. Manual Protozoa, p. 15, figs. 3 *b*, *b′*.

— PICTA, *Blake*, 1876. Yorkshire Lias, p. 462, pl. xix, figs. 6, 6 *a*, *b*.

— RAPHANUS, *Blake*, 1876. Ibid., p. 462, pl. xix, fig. 5.

— — *Jones*, 1876. Monthly Microsc. Journ., pl. cxxix, fig. 9.

— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 114, fig. 18 *h*.

— — var. CREBRICOSTA, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 90, pl. ix, fig. 6.

— — *Terrigi*, 1883. Atti Accad. Pont. N. Lincei, vol. xxxv, p. 180, pl. ii, fig. 17.

— — *Jones*, 1883. Micrôgr. Dict., edit. 4, p. 491, pl. xxiii, figs. 30—32.

— — *Terrigi*, 1883. Atti Accad. Pont. Nuovi Lincei, vol. xxxv, p. 180, pl. ii, fig. 17.

— COSTATA, *Brady*, 1884. Report 'Challenger,' p. 528, pl. lxv, figs. 10—13.

— RAPHANUS, *Jones*, 1884. Quart. Journ. Geol. Soc., vol. xl, p. 769, pl. xxxiv, fig. 6.

— COSTATA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, fasc. 2, p. 192, and p. 201.

NODOSARIA SEMEN, *Doderlein*, = MARGINULINA RAPHANUS, *Malagoli*, 1888. Atti Accad. Modena, ser. 3, vol. vii, fasc. 1, p. 2, pl. i, figs. 1, 2.
MARGINULINA COSTATA, *Sherborn and Chapman*, 1889. Journ. R. Micr. Soc. for 1889, p. 487, pl. xi, fig. 28.
— PECKETI, *Schrodt*, 1890. Zeitsch. Deutsch. Geol. Ges., vol. xlii, p. 409, pl. xxi, fig. 1.
— COSTATA, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 347, pl. xi, fig. 19.
— — *Fornasini*, 1893. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iii, p. 434, pl. ii, fig. 6; vol. iv, 1894, pp. 213, 214, 217, pl. ii, figs. 19—21. (*Nodosaria* and *Marginulina cultrata*, and *Nod. constricta*, Costa.)
NODOSARIA RAPHANUS, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. v, fasc. 4, p. 621, pl. v, figs. 56—59.
MARGINULINA ÆQUIVOCA (Rss.), *Chapman*, 1894. Journ. R. Microsc. Journ. for 1894, p. 162, pl. iv, fig. 20. (Eccentric *Nodosaria raphanus.*)
— MUNIERI (Berth.), *Idem*, 1894. Ibid., p. 163, pl. iv, fig. 22.
— ROBUSTA (Rss.), *Idem.*, 1894. Ibid., p. 163, pl. iv, fig. 23.
— JONESI (Rss.), *Idem*, 1894. Ibid., p. 163, pl. iv, fig. 24.
NODOSARIA MARGINULINOIDES, *Fornasini*, 1895. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. v, p. 10, pl. iv, fig. 7. (A passage-form.)
CRISTELLARIA SULCATA, *Fornasini*, 1895. Ibid., p. 11, pl. iv, figs. 26, 27. (= *Cr. sulcata*, Costa; *M. costata*, with few ribs.)
MARGINULINA COSTATA, *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 35 and 61.

Characters.—This Nodosarine is essentially a *Nodosaria* having an eccentric growth, which gives either an oblique or partially spiral style of growth to the early chambers, and a marginal aperture (with or without a short neck) to the older and the last segments. It varies in cross-section from subcylindrical to oval and compressed. The chambers are moderately compact; more or less septate, and therefore varying in relative fulness; and are marked with longitudinal riblets, as in *Nodosaria raphanus*, of which, indeed, this is essentially only a Marginuline modification.

Occurrence.—*Marginulina costata* seems to be most at home in the North and South Atlantic, the Mediterranean, and the Adriatic (370—1240 fathoms); but

inferior specimens have been met with in British waters and off the coast of New Zealand. Its geological range extends to the Lias of England, Ireland, and France (Brady). It has also been found in the Kimeridge Clay (Brady); in the Cretaceous of Ireland (Wright); in the Eocene (London Clay); and in the Miocene of Italy, Malaga, Vienna, and Muddy Creek. In addition to the record from Sutton in the First Part of the Monograph, we have found one specimen at Broom Hill, zone **d**.

Genus 7.—Cristellaria, *Lamarck*, 1812.

Part I, 1866, page 72.

Brady, Report 'Challenger,' 1884, *pp.* 70 *and* 534.

Additional Synonyms:

Nautilus.—*Plancus, Soldani, Montagu, Dillwyn*, &c.

Polystomella.—*Lamarck, Blainville, Macgillivray, Thorpe.*

Crepidulina.—*Defrance, Blainville.*

Nummulites.—*Keferstein.*

Planularia.—*Defrance, d'Orbigny, Münster, Römer, Hagenow, Philippi, Karsten, Boll, Jones and Parker, Brady, Wright, Blake, Seguenza.*

Robulina.—*Pictet, Michelotti, Bailey, Abich, Egger, Neugeboren, Deecke, Gümbel, Bornemann, Hantken, Mackie, Zwingli and Kübler, Dunikowski, Seguenza, Hagenow, Bailey, Coppi, Malagoli, Andreae, Karsten, Czjzek, Schwager*, &c.

Marginulina.—*Sowerby, Philippi, Cornuel, Jones and Parker, Bornemann, Brady, Gümbel.*

Frondicularia.—*Costa.*

Cristellaria.—*Kübler and Zwingli, Sherborn, Chapman, Brown, Burbach, Gümbel, Berthelin, Schwager, Andreae, Egger, Neugeboren, Hantken, Toutkowsky, Alth, Deecke, Olszewski, Blake, Uhlig, Stache, Dreyer, Toula, Agassiz, Michelotti, Suess, Basset, Quenstedt, Piette, Balkwill, Millett, Koenen, Prestwich, Goës, Egger, Vanden Broeck, Mariani, Dervieux, de Amicis, Fornasini, Rzehak, Nicholson, Bütschli, Marck, Marsson, Mantell, Mackie, Schlicht, Fric, Pictet, Beudant, Dixon, Eley, Mangin, Zittel, Vine, Malagoli, Steinmann, Schlumberger, Dunikowski, Hitchcock, Franzenau, Crouch, Bowdich, Wetherell, Ansted, Chimmo, Neumayer, Schrodt, Murray, Terrigi, Burrows, Bailey, Schacko, Stache, Beissel, Holzapfel, Häusler, Pearcey, Guppy, Crick, Goës*, and others.

General Characters.—See also Part I, p. 72. Test planospiral in part or entirely; discoidal, complanate, lenticular (biconvex), crozier-shaped or ensiform; chambers subtriangular, sickle-shaped or of other hook-like form, mostly compact; smooth, limbate, granulose, or longitudinally costulate.

The smooth lenticular *Cristellaria* without a keel is *C. rotulata* (Lamarck); with a keel *C. cultrata* (Montfort); with broad, dentate keel, *C. calcar* (Linné); and when much compressed, broadly keeled, and ornamented, it is *C. cassis* (Fichtel and Moll). Parker and Jones adopted *C. calcar* as the best central and representative type of *Cristellaria*. *C. cultrata* and *rotulata* are inferior to it in point of development, whilst *C. cassis* surpasses it in the augmentation and diversity of ornamental and marginal growths.

As these forms are very variable in the several features and graduate one into the other, their separation into quasi-species is quite of an artificial character; and it is often difficult to determine to which group some individuals should be allocated. In the following synonymy only the best marked figured specimens have been noted.

C. cultrata, being present in the Crag, is here described.

1. CRISTELLARIA CULTRATA (*Montfort*), 1808. Plate I, figs. 24, 25.

Part I, 1866, Append. I and II, Tables, No. 47.

Cornu Hammonis, *Plancus*, 1739. De Conchis minus notis, &c., p. 12, pl. i, figs. 3, G, H, I;[1] edit. 2, 1760, p. 120, pl. i, figs. xii, S, T, V, and xiii z Z.

Corn-ammone, *Ginanni*, 1757. Opere postum., vol. ii; Test. Adriat., p. 20, pl. xiv, fig. 113.[2]

NAUTILUS CALCAR, *Linné*, 1758. Syst. Nat., 10th edit., p. 709; and 12th edit., 1767, p. 1162, No. 272. [This includes *Cristellaria cassis, calcar*, and *cultrata*.]

Nautili *Circumalati* seu *marginati* grandiusculi, *Soldani*, 1780. Saggio Oritt., p. 97, pl. i, fig. G.

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[1] G. Bianchi states, at p. 13, that the majority of these have a broad pellucid margin around the shell; therefore they are the same as *C. cultrata*. In the 1760 edition there are added to the plate figs. xii, S, T, V, and xiii, Z z, which appear to be true *cultrata*. The fig. 3 quoted above appears to belong to the minority, namely, those without the broad pellucid margin, and is therefore *rotulata*; and this notwithstanding the remark at p. 13, that the artist has not (but might have) shown the marginal flange. See also Fornasini, 'Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 38.

[2] In these posthumous papers of Count Giuseppe Ginanni, of Ravenna, fig. 113 is evidently a bad drawing of *Cristellaria cultrata;* and, as is the case also with figs. 112 and 114, it has an irrelevant description taken wrongly from Plancus. Fig. 111 is one face, and fig. 112 probably the other of *Rotalia Beccarii;* and fig. 114 is possibly a poor *Crist. cassis.*

N. *lævi-lucido-umbilicati*, *Soldani*, 1780. Ibid., p. 99, pl. i, fig. o.
Nautilus calcar, *Walker and Jacob*, 1784. Test. min., &c., p. 19, pl. iii, fig. 66 (and Kanmacher; Adams' Essays).
Nautili (*Lenticulæ marginatæ*), *Soldani*, 1789. Testaceograph., vol. i, part 1, p. 54, pl. xxxiii, figs. A, B.
N. carinati (*Lenticulæ*), *Idem*, 1789. Ibid., p. 64, pl. lviii, figs. *ee*, *ff*, *gg*, *ii*, *kk*, (Figs. *gg* and *ii* have entire keels; but the other specimens either are passages into *C. calcar*, figs. *hh*, *mm*, &c., or have their keels chipped by accident.)
Nautilus calcar, var. β, *Fichtel and Moll*, 1803. Test. Microsc., &c., p. 69, pl. xi, figs. *d*—*f*; var. ζ, pl. xii, figs. *d*—*f*; var. λ, pl. xiii, figs. *e*—*g*.
— — *Montagu*, 1803. Test. Brit., &c., p. 189, pl. xv, fig. 4.
— rotatus, *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 114.
Robulus cultratus, *Montfort*, 1808–10. Conch. Syst., p. 214, genre liv.
Robulina cultrata, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 287, No. 1; Modèle No. 82.
Rotalia, *Sowerby and Wetherell*, 1834. Trans. Geol. Soc., ser. 2, vol. v, p. 135, pl. ix, fig. 13.
Cristellaria Osnaburgensis, *Münster and Roemer*, 1838. Neues Jahrb. f. Min., &c., 1838, p. 391, pl. iii, fig. 62.
Robulina Canariensis, *d'Orb.*, 1839. Foram. Canaries, &c., p. 127, pl. iii, figs. 3, 4.
— cultrata vel subcultrata, *d'Orb.*, 1839. Foram. Amér. Mérid., &c., p. 26, pl. v, figs. 19, 20.
— Ehrenbergii, *Roemer*, 1841. Verstein. Norddeutsch. Kreidegeb., p. 98, pl. xv, fig. 31; R. Comptoni, *Idem*, ibid., fig. 33.[1] (Both are described as being keeled, but Sowerby's figured type of *C. Comptoni* is not keeled.)
— depressa, *Michelotti*, 1841. Mem. Soc. Ital. Sc., vol. xxii, pp. 291 and 302, pl. ii, fig. 3.
— Cummingii, *Idem*. Ibid., p. 292, pl. ii, fig. 4.
— cultrata, *Idem*. Ibid., p. 291, pl. ii, fig. 5.
Cristellaria planicosta, *Hagenow*, 1842. Neues Jahrb. f. Min., &c., 1842, p. 572, pl. ix, fig. 24.
— lobata, *Reuss*, 1845. Verstein. Böhm. Kreid., I, p. 34, pl. xiii, fig. 59.
Robulina cultrata, *d'Orb.*, 1846. Foram. Foss. Vienne, p. 96, pl. iv, figs. 10—13.
— similis, *Idem*. Ibid., p. 98, pl. iv, figs. 14, 15.
— clypeiformis, *Idem*. Ibid., p. 101, pl. iv, figs. 23, 24.
— cultrata, *Pilla*, 1846. Dist. Etruria, p. 104, pl. i, fig. 9.

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[1] Given as fig. 34 in the text, but more correctly fig. 33 at the foot of the plate.

NONIONINA MAGDEBURGICA, *Philippi*, 1846. Palæontographica, vol. ii, p. 81, pl. x A, fig. 21.

ROBULINA CUMMINGI, *Michelotti*, 1847. Nat. Vet. Hollandische Maatschap. Wetensch. Haarlem, ser. 2, vol. iii, p. 14, pl. i, fig. 3.

— STELLIFERA, *Czjzek*, 1848. Haidingers Naturw. Abhandl., vol. ii, p. 142, pl. xii, figs. 26, 27 (narrow keel).

CRISTELLARIA VARIABILIS, *Reuss*, 1850. Densch. k. Akad. Wien, vol. i, p. 369, pl. xlvi, figs. 15, 16.

ROBULINA GALEATA (afterwards CASSIDEA), ANGUSTIMARGO, DIMORPHA, UMBONATA, NITIDISSIMA, TRIGONOSTOMA, DEFORMIS, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesell., vol. iii, pp. 67—70, pl. iv, figs. 21—26, 30.

— D'ORBIGNII, *Bailey*, 1851. Smithsonian Contrib. Knowl., vol. ii, Art. 3, p. 10, pl. o, figs. 9, 10; Phil. Trans., vol. clv, 1865, p. 425.

CRISTELLARIA PLATYPLEURA, *Jones*, 1852. Quart. Journ. Geol. Soc., vol. viii, p. 267, pl. xvi, fig. 12.

ROTALIA INCRASSATA, &c., *Ehrenberg*, 1854. Mikrogeologie,[1] pl. xxiii, figs. 40, 44, 45, 47—50; pl. xxv, I, fig. 40; pl. xxvi, fig. 53 (CRISTELLARIA HOFFMANNI, *Ehr.*); pl. xxvii, figs. 37, 46; pl. xxviii, figs. 43—49, 54, 55; pl. xxx, figs. 27, 32, 35; pl. xxxii, II, figs. 37, 47.

CRISTELLARIA ORBICULA, *Reuss*, 1854. Denksch. k. Akad. Wiss. Wien, vol. vii, p. 68, pl. xxv, fig. 12.

— SUBALATA, *Idem*. Ibid., vol. vii, p. 68, pl. xxv, fig. 13.

— CULTRATA, *Parker, Jones, and Brady*, 1855. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 32.

— PROMINULA, *Reuss*, 1855. Zeitsch. Deutsch. Geol. Gesell., vol. vii, p. 271, pl. ix, fig. 3.

ROBULINA MEGALOPOLITANA, *Idem*. Ibid., p. 272, fig. 5.

CRISTELLARIA EXCISA, *Bornemann*, 1855. Ibid., vol. vii, p. 328, pl. xiii, fig. 20.

ROBULINA DEFORMIS, *Idem*. Ibid., vol. vii, p. 337, pl. xiv, figs. 1—3.

— NAVIS, *Idem*. Ibid., vol. vii, p. 338, pl. xiv, fig. 4.

— AUGUSTIMARGO, *Idem*. Ibid., vol. vii, p. 332, pl. xiv, figs. 6, 7.

— BEYRICHI, *Idem*. Ibid., vol. vii, p. 332, pl. xiv, figs. 8—10?

— INCOMPTA, *Idem*. Ibid., vol. vii, p. 336, pl. xiv, fig. 12.

— RADIATA, *Idem*. Ibid., vol. vii, p. 334, pl. xv, fig. 1.

— LIMBATA, *Idem*. Ibid., vol. vii, p. 335, pl. xv, figs. 4—6.

— TRIGONOSTOMA, *Idem*. Ibid., vol. vii, p. 336, pl. xv, fig. 9.

— DECLIVIS, *Idem*. Ibid., vol. vii, p. 333, pl. xv, fig. 11.

— INTEGRA, *Idem*. Ibid., vol. vii, p. 334, pl. xv, figs. 12—14, 16.

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[1] See also 'Monatsb. and Abhandl. Akad.,' Berlin; and 'Ann. Mag. Nat. Hist.,' March, 1872, pp. 226, 282, 288, 291, 293, 300; September, 1872, pp. 189 190.

Robulina compressa, *Bournemann*, 1855. Zeitsch. Deutsch. Geol. Gesell, vol. vii, p. 338, pl. xv, fig. 17.

— clypeiformis, var. festonata, *Costa*, 1856. Atti Accad. Pontan., vol. vii, p. 196, pl. x, figs. 11, a, b, c.

— subangulosa, *Idem*. Ibid., vol. vii, pl. xiv, figs. 2 a, b, c (feeble keel).

— festonata, *Idem*. Ibid., vol. vii, p. o, pl. xix, figs. 1, a b.

Cristellaria magna, *Idem*. Ibid., vol. vii, p. 193, pl. xix, figs. 2 a, b.

Robulina inæqualis, *Idem*. Ibid., vol. vii, p. 229, pl. xix, figs. 3 a, b (few chambers).

— cultrata, *Idem*. Ibid., vol. vii, p. 198.

— — *Bronn*, 1851–56. Lethæa Geogn., edit. 3, vol. iii, p. 207, pl. xxxv², fig. 9.

— compressa, *Egger*, 1857. Neues Jahrb. f. Min., &c., 1857, p. 297, pl. xv, figs. 12, 13.

Cristellaria calcar (including cultrata), *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, pp. 289—291, pl. x, figs. 10—12.

— prima, *Terquem*, 1858. Mém. Acad. Imp. Metz, 1858, p. 621, pl. iii, fig. 16. (Feeble keel, and last chamber expanding.)

— calcar, *Williamson*, 1858. Rec. Brit. Foram., p. 25, pl. ii, figs. 52, 53. (Almost keel-less.)

— cassis, var., *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, pp. 453, 454, 457, pl. xx, fig. 41.

— — rotulata, *Idem*. Ibid., vol. xvi, pp. 453, 454, 457, pl. xx, figs. 42, 43.

— microptera, *Reuss*, 1860. Sitzungsb. k. Akad. Wiss. Wien, vol. xl, p. 215, pl. viii, fig. 7.

— cultrata, *Silvestri*, 1862. Atti X Congresso Scienz. Ital., p. 17.

— subalata, *Reuss*, 1863. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 76, pl. viii, fig. 10; and pl. ix, fig. 1.

— turgidula, *Idem*. Ibid., vol. xlvi, p. 73, pl. viii, fig. 4.

Robulina radiata, *Idem*, 1864. Ibid., vol. xlviii, p. 54, pl. vi, fig. 65 (many-chambered). [*Cristellaria grata* in 1865.]

— depauperata, *Idem*. Ibid., vol. xlviii, p. 54, pl. vi, figs. 67, 68; pl. viii, figs. 90, 91 var. *callifera* (few-chambered).

— limbosa, *Idem*. Ibid., vol. xlviii, p. 55, pl. vi, fig. 69.

Nodosarina (Cristellaria) cultrata et rotulata, *Jones and Parker*, 1864. Geologist, vol. vii, p. 88.

Cristellaria cultrata, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 32, pl. i, fig. 39.

— — et rotulata, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 344, pl. xiii, figs. 17—19; and pl. xvi, fig. 5. (Fig. 19 is not quite destitute of keel.)

Robulina princeps, *Reuss*, 1865. Sitzungsber. Akad. Wiss. Wien, vol. l, p. 466, pl. v, fig. 3.

Cristellaria gyroscalprum, *Stache*, 1865. Novara-Exped. Geol. Theil., vol. i, part 2; Paläont., p. 243, pl. xxiii, figs. 22 *a*, *b*.

Robulina cultrata, var. antipodum, *Idem*, 1865. Ibid., p. 251, pl. xxiii, figs. 30 *a*, *b*.

— Taettowata, *Idem*, 1865. Ibid., p. 252, pl. xxiii, figs. 32 *a*, *b*.

[Other individuals figured on the same plate illustrate passage-forms and near alliances. A similar remark may be made on Cristellarian groups figured on many a page in the works of Seguenza, Reuss, Bornemann, d'Orbigny, Terquem, and others.]

Cristellaria calcar, var. cultrata, *Reuss*, 1866. Denksch. k. Akad. Wiss. Wien, vol. xxv, p. 145.

— communis, *Kübler and Zwingli*, 1866. Neujahrsblatt Bürgerbibliothek Winterthur, p. 10, pl. i, figs. 22, 23.

— simplex, *Iidem*, 1866. Ibid., fig. 28.

— rotalina, *Iidem*, 1866. Ibid., p. 11, pl. ii, fig. 4.

— cultrata, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, pl. i, figs. 24, 25.

— — *Brady*, 1867. Proc. Somerset Arch. Nat. Hist. Soc., vol. xiii, p. 227, pl. iii, fig. 37.

Robulina alatolimbata, *Gümbel*, 1868. Abhandl. k. Akad. Bayer. Wiss., Cl. II, vol. x, Abth. 2, p. 641, pl. i, fig. 70 (almost vorticial).

— pterodiscoidea, *Idem*, 1868. Ibid., p. 642, pl. i, fig. 72 (many-chambered).

Cristellaria rotalina, *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 10, pl. i, Jurensismergel, fig. 3.

— simplex, *Iidem*, 1870. Ibid., fig. 4; and p. 27, pl. iii, fig. 28.

— communis, *Iidem*, 1870. Ibid., fig. 5; and Posidonienschiefer, fig. 4; and p. 27, pl. iii, fig. 27.

— Birmenstorfensis, *Iidem*, 1870. Ibid., p. 29, pl. iii, fig. 36.

— No. 302, *Schlicht*, 1870. Foram. Pietzpuhl, p. 52, pl. xvi, fig. 1 (*C. spectabilis*, Reuss).

Robulina, No. 313, *Idem*. Ibid., p. 54, pl. xvii, figs. 7, 8 (*C. articulata*, Reuss); No. 316, p. 54, figs. 11, 12 (*C. articulata*, Reuss); No. 319, p. 55, pl. xvii, figs. 17, 18 (*C. simplex*, var. *incompta*, Reuss); No. 320, p. 55, pl. xviii, figs. 1, 2 (the same); No. 322, p. 55, pl. xviii, figs. 3, 4 (*C. deformis*, Reuss); No. 321, p. 55, pl. xviii, figs. 7, 8 (*C. simplex*, var. *incompta*, Reuss); No. 323, p. 55, pl. xviii, figs. 15, 16 (the same); No. 334, p. 57, pl. xix, figs. 13, 14 (*C. limbosa*, Reuss); No. 332, p. 57, pl. xix, figs. 7, 8 (*C. platyptera*, Reuss).

Cristellaria cultrata, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 240, pl. x, fig. 84.

ROBULINA CALCAR, var. CULTRATA, *Hantken*, 1875. Mittheil. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, part 1, p. 55.

— DEPAUPERATA, *Idem*, 1875. Ibid., vol. iv, p. 55, pl. vi, figs. 5, 6; pl. xiv, fig. 16 (figs. 6 and 16 few-chambered).

— PRINCEPS, *Idem*, 1875. Ibid., vol. iv, part 1, p. 56, pl. vi, fig. 8.

— LIMBOSA, *Idem*, 1875. Ibid., vol. iv, part 1, p. 57, pl. vi, fig. 11.

— BUDENSIS, *Idem*, 1875. Ibid., vol. iv, part 1, p. 58, pl. vii, fig. 1 (?).

CRISTELLARIA CULTRATA, *Vanden Broeck*, 1876. Ann. Soc. Belge Microsc., vol. ii, p. 107, pl. iii, figs. 3 and 6; and Fonds de la Mer, vol. iii, 1876, pp. 93, 94, pl. iii, figs. 3 and 6.

— FALCATA, *Karrer*, 1878. Foram. Tert. Thone Luzon, p. 93, pl. v, fig. 19.

ROBULINA TENUIS, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 143, pl. xiii, fig. 26.

— VITREA, *Idem*, 1880. Ibid., ser. 3, vol. vi, p. 144, pl. xiii, fig. 27.

— DUBIA, *Idem*, 1880. Ibid., ser. 3, vol. vi, p. 144, pl. xiii, fig. 30.

CRISTELLARIA CULTRATA, *Terrigi*, 1880. Atti Acc. Pontif. Nuovi Lincei, vol. xxxiii, p. 182, pl. i, fig. 12.

— CIRCUMCIDANEA, *Berthelin*, 1880. Mém. Soc. Géol. France, ser. 3, vol. i, Mém. No. 5, p. 52, pl. iii (xxvi), fig. 1.

— DIADEMATA, *Idem*, 1880. Ibid., p. 51, pl. xxvi, fig. 4.

— MACRODISCA, *Idem*, 1880. Ibid., p. 48, pl. xxvi, fig. 11.

— INGENUA, *Idem*, 1880. Ibid., ser. 3, vol. i, Mém. No. 5, p. 54, pl. xxvi, figs. 20, 21.

— CULTRATA, *Jones*, 1882. Catal. Foss. Foram. Brit. Mus., pp. 9, 14, 19, 21, 43, 52, 55, 56, 69, 71, 79, 87, 90, 94.

NODOSARINA CALCAR (including CULTRATA), *Goës*, 1882. Kongl. Svenska Vet.-Akad. Handl., vol. xix, No. 4, pp. 49—52, pl. iii, figs. 57—59.

CRISTELLARIA ROTULATA, var. ROEMERI, *Uhlig*, 1883. Jahrb. Geol. Reichsanst. Wien, vol. xxxiii, p. 751, pl. ix, figs. 1—3 (with very narrow keel).

— CULTRATA, *Idem*, 1883. Ibid., vol. xxxiii, p. 754.

— — *Jones*, 1883. Micrograph. Dict., edit. 4, p. 214, pl. xxiii, figs. 37 *a*, *b*.

— — *Idem*, 1884. Quart. Journ. Geol. Soc., vol. xl, p. 765, pl. xxxiv, figs. 10, 11.

— ROTULATA, *Jones*, 1884. Ibid., vol. xl, p. 765, pl. xxxiv, fig. 9 (with a slight partial keel).

— CULTRATA, *Brady*, 1884. Report 'Challenger,' pp. 70 and 550, pl. lxx, figs. 4—8.

Cristellaria cultrata, *Fornasini*, 1884. Boll. Soc. Geol. Ital., vol. iii, pp. 89, 90.
— — *Koenen*, 1885. Abhandl. Ges. Wiss. Göttingen, vol. xxxii, p. 107, pl. v, figs. 13 *a*, *b*.
— — *Fornasini*, 1885. Boll. Soc. Geol. Ital., vol. iv, p. 114.
— — — 1886. Ibid., vol. v, pp. 139, 140, 154, 180.
Robulina cultrata, *Basset*, 1885. Ann. Soc. Charente-Inf. for 1884, p. 163, No. 82.
Cristellaria cassis (adult), *Basset*, 1885. Ibid., p. 162, fig. 83.
— mamillaris, *Terquem*, 1886. Mém. Soc. Géol. France, ser. 3, vol. iv, Mém. No. 2, p. 37, pl. iv (x), fig. 4 (only).
— radiata, *Uhlig*, 1886. Jahrb. Geol. Reichsanst., vol. xxxvi, Heft 1, p. 169, cut fig. 2.
— —[1] *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 29.
— inornata, *Sherborn and Chapman*, 1887. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 754, pl. xv, fig. 27 *a*, *b* (feebly carinate).
— cultrata, *Iidem*. Ibid., ser. 2, vol. vi, p. 754, pl. xv, figs. 28 *a*, *b*.
— — var. splendens, *Iidem*. Ibid., ser. 2, vol. vi, p. 755, pl. xv, figs. 29 *a*, *b*.
— megalopolitana, *Iidem*. Ibid., ser. 2, vol. vi, p. 755, pl. xv, fig. 30.
— cultrata, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 224, pl. xliv, fig. 13.
— — var., *Prestwich*, 1888. Geology, vol. ii, p. 352, 175 *c*.
Robulina glauca [*Doderlein*], *Malagoli*, 1888. Att. Soc. Nat. Modena Memorie, ser. 3, vol. vii, p. 4, pl. i, figs. 3—5.
Cristellaria cultrata, *Mariani*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 287, pl. x, fig. 12.
— — *Häusler*, 1890. Abhandl. Schweiz. paläont. Gesell., vol. xvii, p. 114, pl. xv, figs. 4, 5, 11.
— rotulata, var.,[2] *Wisniowski*, 1890. Pamietnik Akad. Umiejet Krakow, vol. xvii, p. 220, pl. ix, fig. 21 *b*.
— cultrata, *Terrigi*, 1891. Mem. Com. Geol. Ital., vol. iv, p. 96, pl. iii, figs. 13—15.
— Soldanii, *Idem*, 1891. Ibid., p. 98, pl. iii, figs. 19, 20.
— depressa, *Dervieux*, 1891. Boll. Soc. Geol. Ital., vol. x, p. 39 pl. i^a, figs. 10, 11.
— cultrata, *Idem*, 1891. Ibid., p. 45.
— Budensis, var., *Idem*, 1891. Ibid., p. 49, pl. i^a, fig. 16.

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[1] Several specimens "differing in size, in the breadth of the keel or crest, in the degree of compression, in the projection of the umbilical disc, or the sutures, &c."

[2] Several modifications of *C. rotulata*, *cultrata*, and *calcar* are figured in pls. ix and x.

CRISTELLARIA CULTRATA, *Idem*, 1892. Boll. Soc. Geol. Ital., vol. x, p. 582.
— — *Malagoli*, 1892. Ibid., vol. xi, p. 95.
— — *Hosius*, 1892. Verhandl. nat. Ver. preuss. Rheinland, 49 Jahrg., p. 189.
— — *Crick and Sherborn*, 1892. Journ. Northamptonshire Nat. Hist. Soc., vol. vii, p. 70, pl. vii, fig. 13.
— ROTULATA, *Egger*, 1893. Abhandl. Bayer. Akad. Wiss., vol. xviii, p. 351, pl. xii, fig. 2 (not quite keelless).
— CULTRATA, *Idem*. Ibid., figs. 7—10, 24, 25.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 417 (synonyms).
— — *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 221, 222, pl. iii, figs. 26, 27; vol. v, 1895, p. 12, pl. iv, fig. 31 (fig. 27 = *Cr. festonata*, Costa).
— ROTULATA (including CULTRATA), *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 59, pl. x, figs. 559—578.
— CULTRATA, *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 43 and 62.
— ROTULATA, *Egger*, 1895. Jahresb. Naturhist. Ver. Passau, p. 26, pl. iii, figs. 4, 7.

NOTE.—The synonymy of *Cristellaria cultrata* and its very numerous allies is dealt with in the "Remarks on the Foraminifera with especial reference to their Variability of Form, illustrated by the Cristellarians," by Prof. T. Rupert Jones, in the 'Monthly Microsc. Journ.,' vol. xv, 1876, pp. 61—92, and pp. 20, 201. At pp. 77—84 the synonymy of the varietal modifications of *Cristellaria calcar*, whether keelless or keeled, rowelled, outspread, trihedral, or elongate, is detailed, as indicated by published forms, from 1735 to 1846. The second part (by T. R. Jones and C. D. Sherborn) of the same memoir appeared in the 'Journ. Roy. Microsc. Society,' vol. for 1887, part 2, pp. 545—557. The selection for the synonymy is chiefly guided by the absence of ornament and of any peculiarity in the shape of the chambers, and doubtless is merely an artificial arrangement of the forms lying between *C. rotulata* and *C. cassis*.

Characters.—Shell lenticular, nautiloid, smooth, consisting of one or more spiral whorls of subtriangular or falciform chambers, the outermost embracing the inner whorls. Septal sutures variable in expression; sometimes sunken, often limbate. Umbones sometimes much thickened. Margin keeled; carina narrow or wide. Aperture round or angular.

Diameter of specimens from the Crag about one-twentieth of an inch ($1\frac{1}{2}$ mm.); but some from other sources attain very much larger dimensions.

Occurrence.—*Cristellaria cultrata* is found in various fossiliferous strata, com-

mencing with the Silurian;[1] it is represented in the Lias and Oolite, and abounds in the Gault, Chalk-marl, and Chalk. Together with cognate forms or varieties, it is plentiful in many Tertiary deposits at home and abroad. Recent specimens are not very common, but have been found in Arctic, Atlantic, and North-Pacific dredgings at considerable depths, and in the Mediterranean and Adriatic Seas. In the Crag it is very rare, one or two smallish specimens from Sutton, and Thorpe, near Norwich, in Mr. Wood's Collection, being the only reliable examples we have seen.

Together with its ally, *C. rotulata*, this *Cristellaria* is widely diffused in seas and oceans, as far north as the Arctic Circle on the coast of Norway, and down south on the shores of Patagonia. Fine specimens are rarely found at less depth than 100 fathoms. *C. cultrata* was collected by the 'Challenger' in the North Atlantic at from 390 to 2435 fathoms; in the South Atlantic at 350 and 675 fathoms; in the South Pacific from 38 to 275 fathoms; and in the North Pacific at 95 fathoms. It lives also in the Mediterranean and Adriatic. Small specimens with narrow keel occur in shallow water in the British seas.

2. Cristellaria gibba, *d'Orbigny*. Plate VII, figs. 19 *a*, *b*.

Cristellaria gibba, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 292, No. 17.
— — *Idem*, 1839. Foram. Cuba, p. 40, pl. vii, figs. 20, 21.
— excisa, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii, p. 328, pl. xiii, fig. 19.
— nuda, *Reuss*, 1861. Sitzungsb. k. Akad. Wiss. Wien, vol. xliv, p. 328, pl. vi, figs. 1—3.
— pulchella, *Idem*, 1862. Ibid., vol. xlvi, p. 71, pl. viii, fig. 1.
Robulina concinna, *Idem*, 1863. Ibid., vol. xlviii, p. 52, pl. v, fig. 58.
Cristellaria gibba, *Brady*, 1884. Report 'Challenger,' p. 546, pl. lxix, figs. 8, 9.
— — *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Micr. Soc., p. 559, pl. x, figs. 19 *a*, *b*, 21.
— — *Crick and Sherborn*, 1891. Journ. Northampt. Nat. Hist. Soc., vol. vi, p. 212, pl. vi, fig. 29.
— — *Chapman*, 1896. Journ. Roy. Micr. Soc. for 1896, p. 4, pl. i, figs. 7 *a*, *b*.

Characters.—This small subovate form is one of the many intermediate to the closely coiled *Cristellaria rotulata* and the more expanded and elongate

[1] *Cristellaria rotulata* (?), Schlumberger, 'Journ. Cincinnati Soc. Nat. Hist.,' vol. v, 1882, p. 119, pl. v, figs. 2, 2 *a*. *Cristellaria*, sp., Terquem, is found in the Devonian, 'Bullet. Soc. Géol. France,' ser. 3, vol. viii, 1880, p. 418, pl. xi, fig. 8.

C. crepidula. It has many congeners, varying in relative thickness and other unimportant features.

Occurrence.—In the North Atlantic and South Pacific at less than 500 fathoms, but it is credited with a much wider area for its habitats. Under various names it may be recognised in descriptions of fossil *Cristellariæ* from both Mesozoic and Cainozoic deposits. We have it from the Crag at Sutton, zone **f**.

It has been found fossil in the Neocomian (Bargate beds); Cretaceous (Red Chalk); Oligocene of Elsass; and the Miocene and Pliocene of Italy.

3. Cristellaria reniformis, *d'Orbigny.* Plate VII, figs. 18 *a, b.*

Cristellaria reniformis, *d'Orb.*, 1846. Foram. Foss. Vienne, p. 88, pl. iii, figs. 39, 40.
— — *Pictet*, 1857. Traité Paléont., edit. 2, vol. iv, p. 495, pl. cix, fig. 13.
— — *Neugeboren*, 1872. Archiv Ver. Siebenburg. Landeskunde, n. f., vol. x, part 2, p. 277, pl. i, figs. 11, 12.
— — *Brady*, 1884. Report 'Challenger,' p. 539, pl. lxx, figs. 3 *a, b.*
— — *de Amicis* 1895. Naturaliste Sicil., vol. xiv, pp. 39 and 62.

Characters.—One of the compressed, long-ovate *Cristellariæ*, nearly straight on one edge nearest to the umbilicus; and boldly curved on the other, which has a crest of variable proportions. Chambers well defined, subtriangular, and gently curved.

Occurrence.—In the North Atlantic at 300 to 1000 fathoms; South Atlantic at 1900 fathoms, South Pacific at 150—1100 fathoms, and North Pacific at 2050 fathoms. In the fossil state it is known from the Eocene (London Clay); Miocene of Hungary, Vienna, and Malaga; and Pliocene of Garrucha, South Spain.

The specimens from the Crag belong to zone **f** at Sutton.

Sub-family 3.—POLYMORPHININÆ.

Brady, Report 'Challenger,' 1884, *pp.* 70 *and* 557.

General Characters.—Segments arranged spirally or irregularly round the long axis; rarely biserial and alternate.

Genus 1.—POLYMORPHINA, *d'Orbigny*, 1826.

Brady, Report 'Challenger,' 1884, *pp.* 70 *and* 557.

Polymorphum.—*Soldani.*
SERPULA.—*Walker and Jacob, Kanmacher.*
VERMICULUM.—*Montagu, Fleming, Macgillivray.*
ARETHUSA.—*Montfort, Bowdich, Fleming, Thorpe.*
MISILUS.—*De Montfort.*
CANTHARUS.—*De Montfort.*
POLYMORPHINA.—*D'Orbigny, Sander Rang, Menke, Ehrenberg, Römer, Macgillivray, Morris, Searles Wood, Philippi, Bronn, Pictet, Reuss, Strickland, Alth, Morris and Jones, Parker and Jones, Egger, Williamson, Terquem, Karrer, Carpenter, von Gümbel, Brady, Stache, Dittmar, Sars, Schwager, Alcock, Bunzel, von Schlicht, von Hantken, Olszewski, Costa, Dunikowski, Berthelin, von Münster, Basset, Blake, Häusler, Bornemann, Zittel, Dawson, Toula, Andreæ, Bütschli, Sherborn, Burrows, Bailey, Deecke, Marsson, Schultze, Walther, Ansted, Chapman, Crick, Goës, Chimmo, Green, Folin, Millett, De Amicis, Fornasini, Guppy, Wisniowski, Mariani, von Hantken,* and others.
GLOBULINA.—*D'Orbigny, Sander Rang, Römer, von Münster, Bronn, Pictet, von Gümbel, Reuss, Alth, Terquem, Morris, Jones, Bornemann, Egger, Karrer, Schwager, von Schlicht, Zwingli, Kübler.*
GUTTULINA.—*D'Orbigny, Sander Rang, Römer, Ehrenberg, Bronn, Pictet, Reuss, Costa, Gümbel, Alth, Morris, Jones, Bornemann, Egger, Karrer, Ansted, Stache, von Schlicht, Terquem, Brady, Parker, Berthelin.*
PYRULINA.—*D'Orbigny, Sander Rang, Reuss, Morris and Jones, Ehrenberg, von Schlicht.*
RENOIDEA.—*Brown.*
RAPHANULINA.—*Zborezewski.*
OPIOPTERINA.—*Zborezewski.*
PROROPORUS.—*Ehrenberg, Reuss.*
AULOSTOMELLA.—*Alth, Pictet.*
BIGENERINA.—*Ehrenberg.*
PLEURITES.—*Ehrenberg, Kübler and Zwingli.*
ROSTROLINA.—*Von Schlicht.*

General Characters.[1]—Bi- or tri-serial or irregularly spiral; aperture central, terminal, round, and radiate, sometimes fissurine or porous; surface smooth or ornamented. Usually free, sometimes adherent.

Polymorphina has been found fossil in the Triassic (Raibl) strata of South Germany, the Lias, and the successive Mesozoic and Cainozoic formations; and its distribution is world-wide at the present time.

1. POLYMORPHINA LACTEA (*Walker and Jacob*), 1789. Plate I, fig. 48.

Part I, 1866, Appendices I and II, Tables, No. 48.

Serpula tenuis ovalis lævis, *Walker and Jacob*, 1784. Test. Min., p. 2, pl. i, fig. 5.
Polymorpha *subcordiformia* vel *oviformia*, *Soldani*, 1791. Testaceogr., vol. i, pt. 2, p. 114, pl. cxii, fig. *gg*.
SERPULA LACTEA, *Walker and Jacob* (fide *Kanmacher*), 1798. Adams's Essays, 2nd edit., p. 634, pl. xiv, fig. 4.
VERMICULUM LACTEUM, *Montagu*, 1803. Test. Brit., p. 522.
— — *Fleming*, 1822. Wern. Mem., vol. iv, p. 566, pl. xv, fig. 6.
POLYMORPHINA (GLOBULINA) OVATA, *d'Orbigny*, 1826. Ann. Sc. Nat., vol. vii, p. 266, No. 22.
ARETHUSA ? LACTEA, *Fleming*, 1828. Hist. Brit. Animals, p. 234.
GLOBULINA CARIBÆA, *d'Orb.*, 1839. Foram. Cuba, p. 135, pl. ii, figs. 7, 8.
GUTTULINA PLANCII, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 60, pl. i, fig. 5.
RENOIDEA OBLONGA, *Brown*, 1844. Illustr. Recent Conch., p. 3, pl. lvi, figs. 16, 17 (in 1st edit., 1827, pl. i, figs. 16, 17).
POLYMORPHINA LACTEA, *Macgillivray*, 1843. Moll. Aberdeen, p. 320.
— (GLOBULINA) LACHRYMA, *Reuss*, 1845. Verstein. böhm. Kreid., pt. 1, p. 40, pl. xii, fig. 6; pl. xiii, fig. 83; and pt. 2, 1846, p. 110.
GLOBULINA LACHRYMA, *Alth*, 1850. Haidinger's Abhandl., vol. iii, p. 363, pl. xiii, fig. 16.
— — *Reuss*, 1851. Ibid., vol. iv, p. 43, pl. v (iv in text), fig. 9.

[1] For details as to the history and affinities of this genus the reader is referred to the "Monograph of the Genus Polymorphina," 'Trans. Linn. Soc.,' vol. xxvii, 1870, pp. 197—253. The critical examination of the Foraminifera depicted in Ehrenberg's 'Mikrogeologie' not having been completed when this Monograph was published in 1870, several inaccuracies were introduced; and certain errors should be corrected, as noticed in the 'Ann. Mag. Nat. Hist.,' ser. 4, vol. ix, 1872, p. 298. Thus—at p. 213 *delete Strophoconus ovum, spicula,* and [*Grammostomum*] *laxum;* at p. 219, *Strophoconus stiliger* and *acanthopus;* at p. 220, *Grammostomum turio;* at p. 223, *Strophoconus Hemprichii;* at p. 224, *Sphæroidina Parisiensis;* at p. 227, the 1st, 2nd, 3rd, 5th, 6th, 8th to the 16th, and the 19th of Ehrenberg's species; and add *Loxostomum vorax*, pl. xxviii, fig. 24; at p. 232 *delete Polymorphina asparagus* and *turio, Sagrina longirostris,* and *Vaginulina obscura;* at p. 233, *Vaginulina paradoxa;* at p. 234, *Polymorphina nucleus;* at p. 238, *Grammostomum costulatum;* at p. 242 add, under *Globulina tuberculata, Proroporus verrucosus*, pl. xxix, fig. 19.

Pyrulina ovulum, *Ehrenberg*, 1854. Mikrogeologie, pl. xxxi, figs. 35, 36.
Polymorphina lactea, *Jones*, 1854. Morris's Catal. Brit. Foss., edit. 2, p. 40.
— Muensteri, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 249, pl. viii, fig. 80.
— ovulum, *Idem*, 1855. Ibid., p. 250, pl. viii, fig. 83.
Globulina Roemeri, *Idem*, 1855. Ibid., p. 245, pl. vi, fig. 63.
Guttulina deformata, *Idem*, 1855. Ibid., fig. 64.
— turgida, *Idem*, 1855. Ibid., p. 246, pl. vi, fig. 66.
Polymorphina lactea (typica in parte), *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 70, pl. vi, fig. 147.
— — var. communis, *Idem*, 1858. Ibid., p. 72, pl. vi, figs. 153—155.
— — [varieties], *J. W. Dawson*, 1859. Canad. Nat., vol. iv, p. 28, figs. 2, 3.
Guttulina diluta, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Gesell., vol. xii, p. 160, pl. vi, figs. 11 *a*—*c*.
Polymorphina lactea, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 454, pl. xx, fig. 44; and p. 302, Table.
— — — 1862. Carpenter's Introd. Foram., p. 311.
— — (typica), *Alcock*, 1865. Proc. Lit. Phil. Soc., Manchester, vol. iv, p. 206.
— — — *Sars*, 1865. Foss. Dyrelevn. fra Qvartærperiod., pp. 55, 62, 65, 68, 85, 91.
— — *J., P., and B.*, 1866. Monogr. For. Crag, Appendices, Tables, No. 48, pl. i, fig. 48.
— tubulosa (part[1]), *Iidem*, 1866. Ibid., Nos. 54, 55, pl. i, figs. 74, 75.
— lactea, *Brady*, 1868. Trans. Geol. Soc. Glasgow, vol. iii, p. 125.
— — *Sars*, 1868. Vidensk.-Selsk. Forhandl. for 1868, p. 248.
— — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.
Guttulina, No. 491, *Schlicht*, 1870. Foram. Pietzpuhl, p. 84, pl. xxxii, figs. 21, 22 ("*Polymorphina sororia*," Reuss, Sitzungs. k. Akad. Wien, vol. lxii, 1870, p. 487).
Polymorphina lactea, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 213, pl. xxxix, figs. 1 *a*—*c*.

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[1] The tubulose *Polymorphinæ* in pl. i, 1866 (see also further on, p. 255), are probably—

Fig. 69, *Polymorphina Soldanii*, d'Orb., striate variety.
„ 70, „ *communis*, d'Orb.
Fig. 71, *Polymorphina rotundata*, Bornemann.
„ 72 and 73 „ *gibba*, d'Orb.
„ 74 and 75 „ *lactea*, W. and J.

A memoir on the tubulose *Polymorphinæ*, of which there are sixty-nine known forms, has lately been communicated to the Linnean Society by T. R. Jones and F. Chapman. They define five groups, namely: (1) with "apical" growths (divisible into five sub-groups,—formæ *damæcornis, coronula, acuplacenta, horrida, et racemosa*); (2) "subapical" growths (forma *circularis*); (3) "on general surface" (forma *diffusa*); (4) "marginal" (forma *marginalis*); (5) "mixed kinds of growths" (forma *complicata*).

Polymorphina lactea, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, pp. 170, 171, No. 64, pl. xi, fig. 104 (after Soldani).
Guttulina disparilis, *Terquem*, 1874. Foram. Syst. Oolithique, p. 309, pl. xxxiii, fig. 23.
Polymorphina Muensteri, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anst., p. 61, pl. vii, fig. 16.
— lactea, *Terquem*, 1875. Plage Dunkerque, p. 37, pl. v, fig. 12.
Guttulina communis, *Idem*, 1875. Ibid., fig. 13.
Polymorphina lactea, *Brady and Robertson*, 1875. Report Brit. Assoc. for 1874, p. 190.
— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
— bucculenta, *Berthelin*, 1880. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 58, pl. xxvii, figs. 16, 17.
Globulina varians, *Terquem*, 1882. Ibid., ser. 3, vol. ii, p. 128, pl. xiii, figs. 9, 15.
Polymorphina lactea, *Brady*, 1884. 'Challenger' Report, p. 559, pl. lxxi, figs. 11, 14, and fistulose form, p. 560, pl. lxiii, fig. 14.
— — *Gümbel*, 1885. Geol. Bayern, Theil 1, Lief 2, p. 421, cut 266, fig. 15.
— oolithica, *Deecke*, 1886. Mém. Soc. d'Emul. Montbéliard, vol. xvi, p. 37, pl. i, fig. 28.
— *aff.* amygdaloides, *Deecke*, 1886. Ibid., figs. 20, 20 *a*.
— bilocularis, *Deecke*, 1886. Ibid., vol. xvi, p. o, pl. i, fig. 11.
— lactea, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 224, pl. xliv, fig. 11 (?).
— — & var. elongata, *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Micr. Soc., p. 561, pl. xi, figs. 9, 10 (?).
— — *Crick and Sherborn*, 1892. Journ. Northamp. Nat. Hist. Soc., vol. vii, p. 71, fig. 25.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. ii, p. 308, pl. ix, figs. 8, 14, 15.
— ? elegantissima, *Idem*, 1893. Ibid., fig. 16.
— lactea, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 54.
— — *Chapman*, 1896. Journ. R. Micr. Soc., p. 9, pl. ii, figs. 3, 4.

Characters.—Shell (typical) ovate, gibbous, slightly asymmetrical; anterior extremity acute; posterior obtuse, rounded. Chambers few, oblong, oblique, somewhat inflated.

The shell of *P. lactea* has normally four or five visible chambers, sufficiently ventricose to disturb the regularity of the general outline; the sutural lines marked by slight depression. In its typical form the transverse section is nearly circular; but this is a variable character, and the compressed modifications described by

Prof. Reuss under the name of *Globulina amygdaloides* may be taken as representing a subvarietal condition.

Occurrence.—Polymorphina lactea is a cosmopolitan species, and has a wide bathymetrical range, although it is most at home in the comparatively shallow waters of temperate latitudes. Specimens obtained from great depths are rare and poorly developed. The geological range of the species extends to the Kimeridge Clay and the Portland Limestone of Dorsetshire (Parker and Jones). *Polymorphina lactea* has been found by Mr. Charles Moore in a Jurassic marly limestone from Queensland, Australia ('Quart. Journ. Geol. Soc.,' vol. xxvii, pp. 236, 239). It has also been found in the Cretaceous of Bohemia and Russia, in the Gault of Folkestone, and in the Red Chalk of Speeton; in the Lower and Middle Tertiaries of Northern and Central Germany; in the Miocene of Piedmont and of Muddy Creek, Victoria; and in the Pliocene of St. Erth.

We have specimens in our own collections from the Casterlian and Scaldisian of Antwerp; and it is found commonly in Pleistocene deposits. In the Coralline Crag we have met with it in every zone examined. It has also been found in the Red Crag of Essex, in the fluvio-marine beds of Southwold and Thorpe, and in the Chillesford beds.

2. Polymorphina gibba,[1] *d'Orbigny*, 1826. Plate I, figs. 49—51.

Part I, 1866, Appendices I and II, Tables, No. 49.

Polymorpha *Subcordiformia* vel *Oviformia, Soldani*, 1791. Testaceographia, vol. i, pt. 2, p. 114, pl. cxiii, figs. *zz*, c.
Globulina gibba, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 266, No. 20; Modèle, No. 63.
— — *S. V. Wood*, 1843. Morris's Catal. Brit. Foss., p. 62.
— globosa, *Reuss*, 1845. Verst. böhm. Kreide, p. 40, pl. xiii, fig. 82.
— gibba, *Reuss*, 1846. In Geinitz's Grundriss, &c., p. 669, pl. xxiv, fig. 84.
— globosa, *Reuss*, 1846. Ibid., p. 669, pl. xxiv, fig. 85.
— gibba, *d'Orb.*, 1846. Foram. Foss. Wien, p. 227, pl. xiii, figs. 13, 14.

[1] Gradations and varieties of *Polymorphina*, including several so-called "species," namely, *P. lactea, gibba, gutta, fusiformis, Burdigalensis, compressa*, are comprised in Beissel's 'Foram. Aach. Kreid.,' 1891, pl. xi, figs. 1—56, and pl. xii, figs. 1—8, under the name *P. proteus*, Beissel. Figs. 9—16 in pl. xii, under the same name, is a *Ramulina*.

Mr. Millett informs us that *A. Silvestri*, in the "Atti e Rendiconti dell' Accad. de Sci. Lettere e Arti dei Zelanti," &c., vol. v, 1893, at page 12, under the name of *Bulimina pyrula*, d'Orb., refers to several figures on pl. v, which may be ascribed to *Polymorphina communis, problema, gibba*, &c.

GLOBULINA PUNCTATA, *d'Orb.*, 1846. Ibid., p. 229, pl. xiii, figs. 17, 18.
— GIBBA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii, p. 80.
— AMPLECTENS, *Reuss*, 1851. Ibid., p. 81, pl. vi, fig. 44.
— INFLATA, *Reuss*, 1851. Ibid., fig. 45.
POLYMORPHINA GIBBA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 283, pl. xi, fig. 32.
— (GUTTULINA) GIBBA, var. α, VERA, *Egger*, 1857. Neues Jahrb., &c., p. 289, pl. xiii, figs. 1—4.
— — — var. β, OVOIDEA, *Egger*, 1857. Ibid., figs. 5—7.
— — — var. γ, SUBGIBBA, *Egger*, 1857. Ibid., figs. 8—10.
— — — var. δ, PYRULA, *Egger*, 1857. Ibid., p. 290, pl. xiii, figs. 11, 12.
— GIBBA, *J., P., and B.*, 1866. Monogr. For. Crag, p. 74, No. 49, pl. i, figs. 49—51.
GLOBULINA AMPLECTENS, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Ges., vol. xii, p. 160, pl. vi, figs. 12 *a—c*.
POLYMORPHINA LACTEA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 359, pl. xiii, figs. 45, 46.
— GIBBA, var. ORBICULARIS, *Karrer*, 1868. Sitz. Akad. Wiss. Wien, vol. lviii, p. 174, pl. iv, fig. 8.
GLOBULINA SUBGIBBA, *Gümbel*, 1868. Abhandl. k. bayer. Akad. Wiss., vol. x, Abth. 11, p. 645, pl. ii, fig. 79.
— No. 425, *Schlicht*, 1870. Foram. Pietzpuhl, p. 75, pl. xxvi, figs. 31—34 (not named by Reuss).
— No. 427 and No. 428, *Schlicht*, 1870. Ibid., pl. xxvii, figs. 1—3, and 4—6 ("*Polymorphina gibba*," Reuss, 'Sitzungsb. k. Akad. Wien,' vol. lxii, 1870, p. 485).
— No. 429 and No. 431, *Schlicht*, 1870. Ibid., figs. 7—9 and 10—12 ("*Polymorphina amygdaloides*," Reuss, ibid., p. 486).
ROSTROLINA, No. 415, *Schlicht*, 1870. Ibid., p. 73, pl. xxvi, figs. 25—27 ("*Polymorphina inflata*," Reuss, ibid., p. 485).
POLYMORPHINA GIBBA, and var. ÆQUALIS. *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, pp. 216, 251, pl. xxxix, figs. 2 *a—d*.
— — *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 190.
GLOBULINA GIBBA, *Terquem*, 1875. Plage Dunkerque, p. 38, pl. v, fig. 15.
— OVIFORMIS, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 44, pl. ix, figs. 9—12.
— GIBBA, *Terquem*, 1878. Ibid., p. 43, pl. ix, figs. 1—5.
POLYMORPHINA GIBBA, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
— SUBSPHÆRICA, *Berthelin*, 1880. Mém. Soc. Géol. Fr., sér. 3, vol. i, p. 58, pl. xxvii, fig. 18.

POLYMORPHINA (GLOBULINA) GIBBA, *Andreae*, 1884. Abhandl. geol. Special-Karte Elsass-Loth., pp. 209, 233, pl. ix, figs. 10—13.
— GIBBA, *Brady*, 1884. 'Challenger' Report, p. 561, pl. lxxi, fig. 12.
— (GLOBULINA) GIBBA, *Basset*, 1885. Ann. Soc. Sci. N. Char.-Inf., No. 21, p. 161, fig. 63.
— GIBBA, *Sherborn and Chapman*, 1886. Journ. Roy. Microsc. Soc., ser. 2, vol. vi, p. 755, pl. xvi, fig. 5.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 55, pl. ix, figs. 522—526, vars. ?).
— — (forma FISTULOSA), *De Amicis*, 1895. Nat. Sicil., xiv, p. 45.
— — *Chapman*, 1896. Journ. R. Micr. Soc., p. 9, pl. ii, figs. 5, 6.

Characters.—Shell (typical) subspherical or oval, somewhat produced at the apex, broad and rounded at the base. Chambers few, compact, and overlapping. Sutures marked, not depressed.

Polymorphina gibba is perhaps as definite in typical characters, and as apt for technical description as any member of the group; still some latitude must be allowed in the terms employed for its diagnosis. D'Orbigny's 'Modèle,' No. 63, represents a nearly globular shell, and may be taken as representing the normal form. Our list of synonyms refers to specimens deviating in no striking particular from this standard.

The shape of the anterior portion of the shell differs considerably in different individuals. In some it is acuminate, and the orifice is situate in a mammillate protuberance; in others it is truncate, and the general aperture is flush with the body of the shell. In rare examples the orifice is turned inwards, like that of an Entosolenian *Lagena*.

A compressed variety sometimes occurs bearing a similar relation to *P. gibba* that *P. lactea*, var. *amygdaloides*, does to *P. lactea;* and of this d'Orbigny's *Globulina æqualis* is perhaps the best representative: its synonymy will be found in the Monograph of the genus, *op. cit.*, pp. 216, 217.

The leading features of the *tubulose forms* of the *Polymorphinæ* shown by figs. 70—75 in Plate I indicate *P. gibba* as one of their types. Fig. 71 leans towards *P. lactea;* and fig. 74 has a tendency to protrude one of its chambers, like *P. problema*, but not enough. As for the style of the outgrowths, fig. 70 has them *complicated*,—that is, both apical and subapical; fig. 71 seems to have had a flat apical mass giving off lateral branches,—*acuplacental;* figs. 72, 74, 75 had a very free-growing, branching (*racemose*), apical outgrowth; and fig. 73 had an extraneous growth both on the apex and general surface (*diffuse*); fig. 76 is evidently the exposed base of a *racemose*, or possibly of a *placental* (cake-like) growth.

Occurrence.—The geographical range of *Polymorphina gibba* is co-extensive with that of *P. lactea.* It has also a very extended geological range. It has been obtained from the Kimeridge Clay of England, and from the Cretaceous of Europe generally; and it is a common Tertiary Foraminifer, as will be seen by reference to the Table of Distribution in the Appendix. In the Pliocene it is recorded from the Diestian, Casterlian, and Scaldisian of Antwerp, from Italy, Garrucha, and St. Erth. In the Coralline Crag we have found it in nearly every zone examined.

3. Polymorphina gutta, *d'Orbigny*, 1826. Plate I, figs. 46, 47.

Part I, 1866, Appendices I and II, Nos. 53, 54.

Polymorphum, *Soldani*, 1789. Testaceographia, vol. i, pt. 2, pl. cxxii, fig. *gg* (not referred to in the text).
Pyrulina gutta, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 267, No. 28, pl. xii, figs. 5, 6; Modèle, No. 30.
Polymorphina clavata, *Römer*, 1838. Neues Jahrb., &c., p. 386, pl. iii, fig. 38.
Pyrulina gutta, *Reuss*, 1861. Model, Catal. 1861, No. 68; Catal. 1865, No. 96.
— obtusa, *Reuss*, 1862. Sitz. Akad. Wiss. Wien, vol. xlvi, p. 79, pl. ix, fig. 9.
Polymorphina (Pyrulina) gutta, *Parker and Jones*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 440, No. 21.
— — — *P., J., and B.*, 1865. Ibid., vol. xvi, p. 24, pl. ii, fig. 51.
— gutta, *J., P., and B.*, 1866. Monogr. For. Crag, Appendix I, No. 53, pl. i, figs. 46, 47.
Rostrolina, No. 408, *Schlicht*, 1870. Foram. Pietzpuhl, p. 72, pl. xxvi, figs. 4—6 (= "*Polymorphina sororia*," Reuss, 'Sitzb.Ak. Wien,' vol. lxii, 1870, p. 487).
— No. 409, *Schlicht*, 1870. Ibid., figs. 1—3 (= "*P. lanceolata*," Reuss, ibid.).
— No. 411, *Schlicht*, 1870. Ibid., figs. 10—12 (= "*P. sororia*," Reuss, ibid.).
Polymorphina gutta, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 218, pl. xxxix, fig. 3.
— — *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 171, pl. xi, fig. 107.
— (Pyrulina) gutta, *Basset*, 1885. Ann. Soc. Sci. Nat. Char.-Inf. for 1884, p. 161, fig. 30.
— gutta, *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 755, pl. xvi, fig. 6.
— — *Chapman*, 1896. Ibid. for 1896, p. 10, pl. ii, figs. 7, 8.

Characters.—Shell ovate-elongate, symmetrical, pyriform; anterior portion tapering, acuminate; posterior obtuse, rounded; margin entire, septal lines not depressed. Chambers elongate, closely embracing, arranged triserially.

Polymorphina gutta, in good specimens, presents tolerably definite characters, its triserial arrangement, closely embracing chambers, and circular transverse section being sufficient for ordinary diagnosis. Its long, tapering upper extremity and numerous chambers distinguish it from *P. gibba*, and the rounded base and compact spiral build from its nearest ally, *Polymorphina* (*Pyrulina*) *acuminata*, d'Orb.

Occurrence.—*Polymorphina gutta* has not hitherto been recorded in the recent condition. It is best known as a Tertiary fossil, but has been found in the Hils Clay (Neocomian) of Germany, in the English (Bargate) Beds of similar age, and in the Gault of Folkestone. Specimens have been recorded from the Eocene (London Clay and Barton Beds), from the Oligocene of Pietzpuhl, and from the Upper Tertiaries of North Italy.

We have nothing to add to the record given in the six columns of the Table, and Appendix II, Part 1, 1866, so far as the occurrence in the Crag is concerned.[1]

4. POLYMORPHINA SORORIA, *Reuss*, 1863. Plate VI, figs. 13 *a*, *b*.

POLYMORPHINA (GUTTULINA) SORORIA, *Reuss*, 1863. Bull. Acad. Roy. Belg., sér. 2, vol. xv, p. 151, pl. ii, figs. 25—29.

— — — — 1864. Sitzungsb. k. Akad. Wien, vol. xlviii, pp. 57 and 67, pl. vii, figs. 72—74.

— — — — 1870. Ibid., vol. lxii, p. 487, No. 9.

VULVULINA MINUTISSIMA (?), *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 30, pl. iii, fig. 42.

— EICHBERGENSIS (?), *Zwingli and Kübler*, 1870. Ibid., figs. 43, 43 *a*.

POLYMORPHINA SORORIA, *Brady*, 1884. 'Challenger' Report, p. 562, pl. lxxi, figs. 15, 16; pl. lxxiii, fig. 15.

— — *Walther*, 1888. Mitth. Neapol., vol. viii, p. 382, pl. xx, fig. 4.

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[1] We have, however, grave doubts as to the occurrence of *P. gutta* in the Crag. We are inclined to think that figs. 46 and 47, pl. i, might be more correctly described as *P. lactea*. Unfortunately no edge views are given.

Although stated in Part 1 of the Monograph to be very common, we have not been able to find one specimen in our own sortings.—H. W. B. and R. H.

Polymorphina sororia (?), *Egger*, 1893. Abhandl. k. Akad. Bayer., vol. xviii, Abth. 2, p. 308, pl. ix, fig. 20.
— — *Chapman*, 1896. Journ. R. Micr. Soc., p. 12, pl. ii, figs. 11, 12.

Characters.—More or less oviform and compressed, sometimes subfusiform; suboval in transverse section; broad about the middle, rounded below, obtusely pointed above. Five or six chambers, variable in size, irregularly subspiral. This form is nearly allied to the typical *P. communis.*

Occurrence.—*Polymorphina sororia* is stated in the 'Challenger' Report to have been found at two stations in the North Atlantic, west of Ireland, at depths of 808 and 1443 fathoms; also midway between Cape of Good Hope and Kerguelen Island (1375 fathoms). It was also found by the 'Gazelle' off Sierra Leone, at a depth of 367 fathoms (Egger).

As a fossil it has been recorded from the Chalk of Taplow; from the Oligocene of Elsass and Pietzpuhl; and from the Pliocene of Belgium and St. Erth. The Crag specimens were obtained from Broom Hill (zone **d**) and Aldborough (zone **g**).

5. Polymorphina compressa, *d'Orbigny*, 1846. Plate I, figs. 54, 65, 77—80; and (distorted) Plate V, figs. 26 and 28.

Part I, 1866, Appendices I and II, Tables, Nos. 55, 56.

Orthoceras *tuberosum, Soldani*, 1791. Testaceographia, vol. i, pt. 2, p. 99, pl. cvii, fig. *kk*.
Polymorpha *Subovalia, Soldani*, 1791. Ibid., p. 114, pl. cxiv, F; pl. cxv, N; pl. cxvi, X.
Polymorphina tuberosa, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 265, No. 6 (ref. Soldani, cvii, *kk;* bad figure).
— compressa, *d'Orb.*, 1846. For. Foss. Wien, p. 233, pl. xii, figs. 32—34.
— acuta, *d'Orb.*, 1846. Ibid., p. 234, pl. xiii, figs. 4, 5; pl. xiv, figs. 5—7.
Guttulina elliptica, *Reuss*, 1846. Verst. böhm. Kreide, p. 110, pl. xxiv, fig. 55.
— — *Alth*, 1850. Haidingers Naturwiss. Abhandl., vol. iii, p. 262, pl. xiii, fig. 15.
Polymorphina insignis, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 248, pl. vii, figs. 74, 75.
— subdepressa, *Reuss*, 1855. Ibid., p. 249, pl. viii, fig. 81.
— crassa, *Reuss*, 1855. Ibid., p. 250, pl. viii, fig. 82.

POLYMORPHINA INCERTA, *Egger*, 1857. Neues Jahrb., &c., p. 286, pl. xiii, figs. 19—21.

— MEDIA, *Egger*, 1857. Ibid., p. 287, pl. xiii, figs. 28, 29.

— LACTEA, *Williamson*, 1858. Rec. Foram. Gt. Britain, p. 70, pl. vi, figs. 145, 146.

GLOBULINA DISCRETA, *Reuss*, 1864. Sitz. k. Akad. Wiss. Wien, vol. l, p. 468, pl. iii, fig. 3.

— ROBUSTA, *Reuss*, 1864. Ibid., p. 470, pl. iii, figs. 5—7.

POLYMORPHINA ANGUSTATA, *Terquem*, 1864. 4me Mémoire Foram. Lias, p. 296, pl. xii, figs. 33—35.

— PYRIFORMIS, *Terquem*, 1864. Ibid., p. 298, pl. xii, figs. 41—43.

— SINUATA, *Terquem*, 1864. Ibid., fig. 48.

— INCAVATA, *Stache*, 1865. Novara-Reise, Geol. Theil, vol. i, p. 260, pl. xxiv, fig. 7.

— SACCULUS, *Stache*, 1865. Ibid., p. 259, pl. xxiv, fig. 6.

— PYGMÆA, *Schwager*, 1865. Württ. Naturwiss. Jahreshefte, vol. xxi, p. 138, pl. vii, fig. 8.

— LACTEA, var. COMPRESSA, *Parker and Jones*, 1865. Phil. Trans. vol. clv, p. 361, pl. xiii, figs. 47, 49—51.

— COMPRESSA, *J., P., and B.*, 1866. Mon. For. Crag, App., Nos. 55 and 56, pl. i, figs. 54, 65, 77—80.

— SEMITECTA, *Reuss*, 1867. Sitz. k. Akad. Wiss. Wien, vol. lv, p. 91, pl. iii, fig. 10.

— ZEUSCHNERI, *Reuss*, 1867. Ibid., p. 90, pl. iv, fig. 1.

— COMPRESSA, *Brady*, 1867. Proc. Somerset. Arch. Nat. Hist. Soc. vol. xiii, p. 230, pl. iii, fig. 50.

— No. 495 and No. 496, *Schlicht*, 1870. Foram. Pietzpuhl, p. 85, pl. xxxii, figs. 29—32, and figs. 35—38 ("*Polym. Humboldti*, Bornemann," according to Reuss).

— COMPRESSA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.

VULVULINA EICHBERGENSIS, *Zwingli and Kübler*, 1870. Foram. schweiz. Jura., p. 30, pl. iii, fig. 43.

POLYMORPHINA COMPRESSA, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 227, pl. xl, fig. 12.

— — *P., J., and B.*, 1871. Ann. and Mag. Nat. Hist., ser. 4, vol. viii, p. 170, No. 62, pl. ii, fig. 105.

— PYRIFORMIS, *Terquem*, 1874. For. Syst. Oolithique, p. 302, pl. xxxiii, fig. 2.

— AMYGDALA, *Terquem*, 1874. Ibid., p. 301, pl. xxxii, figs. 28—30.

— POLYGONA, *Terquem*, 1874. Ibid., p. 304, pl. xxxiii, figs. 8, 11, 14.

— DISJUNCTA, *Terquem*, 1874. Ibid., p. 303, pl. xxxiii, fig. 3.

— ANNULATA, *Terquem*, 1874. Ibid., p. 304, pl. xxxiii, figs. 5, 6.

— POLYGONA, *Terquem and Berthelin*, 1875. Mém. Soc. Géol. Fr., ser. 2, vol. x, pp. 66, 70, pl. xvi, fig. 3.

GUTTULINA LIASINA, *Terquem and Berthelin*, 1875. Mém. Soc. Géol. Fr., ser. 3, vol. x, p. 70, pl. xvi, fig. 4.
POLYMORPHINA COMPRESSA, *Brady*, 1875. Rep. Brit. Assoc. for 1874, p. 190.
— LACTEA, *Terquem*, 1876. Dunkerque, p. 79, pl. x, figs. 19, 20.
— COMPRESSA, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii, fig. 32.
— BURDIGALENSIS, *Blake*, 1876. Ibid., p. 471, pl. xvii, fig. 36.
— SCHWAGERI, *Karrer*, 1877. Abhandl. k. k. geol. Reichsanstalt, vol. ix, p. 384, pl. xiv *b*, fig. 43.
— GIGAS, *Karrer*, 1877. Ibid., fig. 44.
— COMPRESSA, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
— AMYGDALOIDES, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 39, pl. viii, fig. 26.
— UNDULOSA, *Terquem*, 1878. Ibid., p. 41, pl. viii, figs. 35, 36.
— FISCHERI, *Terquem*, 1878. Ibid., fig. 37.
— AMYGDALOIDES, *Terquem*, 1882. Ibid., vol. ii, p. 141, pl. xxii, figs. 30, 31.
— AMYGDALA, *Deecke*, 1884. Abhandl. geol. Specialkarte Elsass-Loth., p. 56, pl. ii, fig. 19.
— COMPRESSA, *Brady*, 1884. 'Challenger' Rep., p. 565, pl. lxxii, figs. 9—11; *fistulose*, p. 556, pl. lxxiii, fig. 17.
— aff. AMYGDALA, *Deecke*, 1886. Mém. Soc. Emul. Montbéliard, vol. xvi, p. 37, pl. i, fig. 20.
— POLYGONA, *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. vi, p. 63, pl. xiii, fig. 18.
— LACTEA, *Dawson*, 1886. Handbook Zoology, p. 44, fig. 34.
— COMPRESSA, *Brady*, 1887. Journ. Roy. Micr. Soc., p. 914.
— — *Mariani*, 1888. Boll. Soc. Geol. Ital., vol. vii, p. 288, pl. x, fig. 13.
— COMMUNIS (?), *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Microsc. Soc., p. 561, pl. xi, fig. 11.
— EICHBERGENSIS, *Wisniowski*, 1890. Mem. Acad. Sci. Cracow, vol. xvii, p. 52, pl. x, fig. 25.
— LIASICA, *Mariani*, 1891. Boll. Soc. Geol. Ital., vol. x, p. 729, pl. i, fig. 20.
— COMPRESSA, *Egger*, 1893. Abhandl. bayer. Akad., vol. xviii, p. 309, pl. ix, figs. 11—13.
— — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 58, pl. x, figs. 539—553.
— — *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 14, pl. ii, fig. 16.

Note.—D'Orbigny's name "*compressa*" has been generally adopted, because the possibly similar form "*tuberosa*" is based on a bad figure.

Characters.—Shell oblong, inequilateral, compressed, more or less fusiform. Chambers numerous, arranged in two unequal series, somewhat inflated. Septal lines depressed. Surface smooth. Aperture variable, usually simple, circular, and coronate, sometimes labyrinthic or porous.

A somewhat indefinite biserial arrangement, in which the segments appear irregularly opposed to each other rather than in alternation, together with the rounded margins and constricted septa, are characters sufficient for general diagnosis. The difficulty in distinguishing attenuated specimens from those of *P. cylindroides* is confessedly great; but the less compressed contour of the latter, its few chambers, and their erect position, will usually serve the purposes of the systematist.

A specimen of irregular growth is shown by fig. 26, Pl. V. It is so much encrusted with carbonate of lime that it presents a false resemblance to *P. variata*.

Occurrence.—Polymorphina compressa has a wide range, but is most common in the comparatively shallow waters of temperate latitudes. It has been found as far north as Smith Sound and Novaya Zemlya; also in the tropical South Atlantic and the North and South Pacific. It mostly affects shallow water, but specimens have been found at depths of from 400 to 600 fathoms.

In the fossil condition *P. compressa* has been recorded from the Lower and Middle Lias of the north part of France, and from the Middle and Upper Lias of Somerset. It has been found also in the Lower Oolite of Somerset; in the Oxford and Kimeridge Clays; in the Cretaceous of England, France, Germany, and North America. We have not observed any records from Eocene deposits; but it has been recorded from the Oligocene of Germany, from the Miocene of Vienna and Muddy Creek (Victoria), from the Pliocene of Belgium and St. Erth, and from the Pleistocene of Norway and the West of Scotland. In the Crag we have met with it in every zone examined.

6. Polymorphina Thouini, *d'Orbigny*, 1826. Plate I, fig. 59.

Polymorphina Thouini, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 265, No. 8, Modèle, No. 23.

Bigenerina Cretæ, *Ehrenberg*, 1854. Mikrogeologie, pl. xxviii, fig. 21.

— acanthophora, *Ehrenberg*, 1854. Ibid., pl. xxviii, fig. 22.

Proroporus Cretæ, *Ehrenberg*, 1854. Ibid., pl. xxvii, fig. 29; and pl. xxviii, fig. 20.

— siculus, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 18.

Polymorphina pupiformis, *Terquem*, 1864. Foram. Lias, 4e Mém., p. 300, pl. xiii, figs. 23, &c.

— Thouini, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 22, pl. ii, fig. 49.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, App. I and II, Tables, No. 50, pl. i, fig. 59.

— — *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 232, pl. xl, fig. 17.

GUTTULINA, No. 466, *Schlicht*, 1870. Foram. Pietzpuhl, p. 81, pl. xxv, figs. 13, 14 (= *P. lanceolata*, Reuss).
POLYMORPHINA PUPIFORMIS, *Terquem*, 1874. Foram. Syst. Oolithique, 4e mém., p. 303, pl. xxxiii, fig. 4 (near *P. compressa*).
— THOUINI, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, pp. 48 and 54.
— — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 142, pl. xxii, fig. 33.
— — *Brady*, 1884. 'Challenger' Report, p. 567, pl. lxxii, fig. 18.
— — *Basset*, 1885. Ann. Soc. Sci. Char.-Inf., No. 21, p. 161, fig. 23.
— PUPIFORMIS, *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. iv, p. 63, pl. xiii, fig. 19.
— THOUINI, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 59, pl. x, figs. 557, 558.

Characters.—Shell attenuate, subcylindrical, slightly constricted at the septal lines. Anterior extremity acute; posterior rounded. Chambers elongate, oblique, erect, slightly ventricose.

Of the very long, many-chambered *Polymorphinæ*, perhaps *P. Thouini* is the best-defined variety; yet the name does not appear to have been generally adopted by authors. It represents a longer, more cylindrical subtype than *P. fusiformis*, with a larger number of chambers and less oblique setting-on; indeed, it resembles more a much outdrawn specimen of *P. problema* than any other variety.

Occurrence.—*Polymorphina Thouini* is of rare occurrence in recent waters. The records given in the 'Challenger' Report are from the Levant (90 fathoms), and off East Moncœur Island, Bass Strait (38 fathoms). In a fossil condition the species is also somewhat rare. It has been obtained from the Lias (Terquem); from the Eocene (Calcaire-grossier) of the Paris Basin; from the Oligocene of Pietzpuhl; and from the Pliocene of Italy. In addition to the record for the Coralline Crag, given in Appendix II, Part I, we have specimens from Sudbourne Hall, zone **d**, and Broom Hill, zones **d** and **e**.

7. POLYMORPHINA NODOSARIA, *Reuss*, 1864. Plate I, figs. 55—58 (*Dimorphina*).

Part I, 1866 ("*Dimorphina nodosaria*," in part), Appendix I, and Appendix II, Tables, No. 57.

POLYMORPHINA SUBNODOSA (?), *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien, vol. xlii, p. 362, pl. ii, fig. 15.

POLYMORPHINA NODOSARIA, *Reuss*, 1864. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 58, pl. vii, fig. 85.

— QUADRATA (in part), *Terquem*, 1864. Quatrième Mém. Foram. Lias, p. 296, pl. xii, figs. 27, &c.

— NODOSARIA, *Reuss*, 1866. Denkschr. k. Akad. Wissensch., vol. xxv, p. 155.

DIMORPHINA NODOSARIA (part), *J., P., and B.*, 1866. Monogr. For. Crag, pl. i, figs. 55—58.

POLYMORPHINA NODOSARIA, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xvii, p. 233, pl. xl, figs. 18 *a*, *b*.

— — *Blake*, 1876. Yorkshire Lias, p. 471, pl. xvii, fig. 34.

— SUBCYLINDRICA, *Hantken* (1875), 1881. Mitth. Jahrb. k. Ung. geol. Anstalt, vol. iv, p. 60, pl. xiv, fig. 14.

Characters.—Shell elongate, cylindrical, somewhat tapering; chambers four to eight, oblique, short, alternating.

Occurrence.—*Polymorphina nodosaria*, so far as is at present known, does not occur in recent seas. Fossil specimens have been obtained only from Tertiary deposits, namely the Middle Tertiaries of Central Germany and Hungary; and the Pliocene of Antwerp and St. Erth. In the Coralline Crag it has been met with only at Sutton.

8. POLYMORPHINA CYLINDROIDES, *Roemer*, 1838. Plate VI, figs. 15 *a*, *b*.

POLYMORPHINA CYLINDROIDES, *Roemer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii, fig. 26.

— — *Philippi*, 1844. Tertiärverstein. Nord-West Deutschl., p. 41.

PROROPORUS CYLINDROIDES, *Reuss*, 1845. Geinitz's Grundriss Verst., p. 678, pl. xxiv, fig. 80.

POLYMORPHINA CYLINDROIDES, *Karsten*, 1849. Verzeichn. Rostock Verst. Steinberger Gestein, p. 8.

— — *Reuss*, 1855. Sitzungsb. k. Akad. Wiss. Wien, vol. xviii, p. 249, pl. viii, fig. 78.

— LACTEA, var. ACUMINATA, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 71, pl. vi, fig. 148.

— COMPRESSA (part), *Parker and Jones*, 1864. Phil. Trans., vol. clv, p. 361, pl. xiii, figs. 48 *a*, *b*.

GUTTULINA, No. 471, *Schlicht*, 1870. Foram. Pietzpuhl, p. 81, pl. xxxi, figs. 5, 6 ["*P. lanceolata*," Reuss, Sitz. Akad., 1870, p. 33].

POLYMORPHINA CYLINDROIDES, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc. vol. xxvii, p. 221, pl. xxxix, figs. 6 *a*—*c*.

— — *Brady*, 1887. Journ. Roy. Micr. Soc., p. 914.

Characters.—Shell elongate, fusiform, more or less compressed; acuminate or subacuminate at the ends. Chambers elongate, in two parallel series, with slightly depressed sutures.

Occurrence.—*Polymorphina cylindroides* is not recorded in the 'Challenger' Report, nor in Egger's report on the voyage of the 'Gazelle.' It has been dredged off Skye by Mr. Barlee; also in some other northern localities.

The type-specimens were obtained by Count Münster from the Newer Tertiaries of North Germany. It has been figured by von Schlicht from the Oligocene of Pietzpuhl.

In the Crag we have specimens from Broom Hill, zone e, and Gedgrave, zone **f**.

9. Polymorphina concava, *Williamson*, 1857. Plate V, fig. 22.

Polymorphina lactea, var. concava, *Williamson*, 1857. Rec. Foram. Great Britain, p. 72, pl. vi, figs. 151, 152.
— concava, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 236, pl. xl, fig. 22.
— — *Brady and Robertson*, 1875. Report Brit. Assoc. for 1874, p. 190.
— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., No. 2, p. 54.
— — *Millett*, 1885. Rep. and Trans. Penzance Nat. Hist. and Antiq. Soc., p. 28.
— — *Brady*, 1887. Journ. Roy. Microsc. Soc., p. 914.
— — *Halkyard*, 1889. Rep. Manchester Microsc. Soc., p. 68.

Characters.—Shell oval or oblong, concave or flat on one face, somewhat convex on the other; chambers like those of *P. lactea* or *P. gibba*, bordered by a broad, irregular, thin flange; parasitical.

Occurrence.—*Polymorphina concava* is very rare in the recent condition. Williamson's specimens were obtained from Brixham, and we are not aware that it has been met with elsewhere than off our own coasts. A fossil specimen has been found in the Neocomian (Bargate beds) of Surrey. It has not been recorded from any of the Tertiary formations older than the Pliocene. Mr. Millett has found it in the St. Erth beds; and we have it from the Casterlian of the Kattendyke Docks, Antwerp. Mr. Millett has it from the Post-glacial beds of March, Cambridgeshire, and from the 'Challenger' dredgings of Station 185, Raine Island, at 155 fathoms. The figured specimen is from the Coralline Crag at Gomer; we have specimens from Gedgrave, zone **f**.

10. POLYMORPHINA COMMUNIS, *d'Orbigny*, 1826. Plate V, fig. 24; Plate VI, figs. 16 *a*, *b*.

POLYMORPHINA (GUTTULINA) COMMUNIS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 266, No. 15, pl. xii, figs. 1—4; Modèle, No. 62.

— — — *Roemer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii, fig. 29.

— OBLONGA, *Roemer*, 1838. Ibid., p. 386, pl. iii, fig. 34.

GUTTULINA VITREA, *d'Orb.*, 1839. Foram. Cuba, p. 133, pl. ii, figs. 1—3.

POLYMORPHINA GLOMERATA, *Reuss*, 1845. Verst. böhm. Kreid., p. 40, pl. xii, fig. 32.

GUTTULINA COMMUNIS, *Reuss*, 1846. In Geinitz's Grundriss Verstein., p. 668, pl. xxv, fig. 8.

— — *d'Orb.*, 1846. For. Foss. Vien., p. 224, pl. xiii, figs. 6—8.

GLOBULINA IRREGULARIS, *Idem*, 1846. Ibid., p. 226, pl. xiii, figs. 9, 10.

— DISCRETA, *Reuss*, 1850. Denks. k. Akad. Wiss. Wien, vol. i, p. 378, pl. xlviii, fig. 10.

GUTTULINA CRETACEA, *Alth*, 1850. Haidingers Naturwiss. Abhandl., vol. iii, p. 262, pl. xiii, fig. 14.

GLOBULINA CRETACEA, *Reuss*, 1851. Ibid., vol. iv, p. 44, pl. iv, fig. 10.

GUTTULINA SEMIPLANA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesell., vol. iii, p. 82, pl. vi, fig. 48.

— ROBUSTA, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 246, pl. vi, fig. 65.

POLYMORPHINA (GUTTULINA) COMMUNIS, *Egger*, 1857. Neues Jahrb., &c., p. 289, pl. ix, figs. 16—18.

— LATA, *Idem*, 1857. Ibid., p. 288, pl. ix, figs. 22—24.

GLOBULINA TUBULIFERA, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Gesell., vol. xii, p. 160, pl. vi, fig. 10.

— BULLOIDES, *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien., vol. xliv, Abth. 1, p. 318, pl. iii, fig. 4.

POLYMORPHINA PROBLEMA, var. DELTOIDEA, *Reuss*, 1865. Denks. k. Ak. Wiss. Wien, vol. xxv, p. 154, pl. iv, fig. 8.

— COMMUNIS, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 29, pl. ii, fig. 47 (referred to *P. lactea*).

GUTTULINA FISSURATA, *Stache*, 1865. Novara-Reise, Geol. Theil, vol. i, p. 263, pl. xxiv, fig. 10.

— OBLIQUATA, *Idem*, 1865. Ibid., vol. i, p. 264, pl. xxiv, fig. 11.

— No. 435, *Schlicht*, 1870. Foram. Pietzpuhl, p. 76, pl. xxvii, figs. 22—25 [= *Polymorphina semiplana*, Reuss, 1870, Sitzb. Akad., vol. xlii, p. 34].

GUTTULINA, No. 447, *Schlicht*, 1870. Foram. Pietzpuhl, p. 78, pl. xxx, figs. 13—16. [= *P. problema*, var. *communis*, Reuss, Sitz. Akad., 1870, p. 33.]

POLYMORPHINA, No. 493, *Schlicht*, 1870. Ibid., p. 84, pl. xxxii, figs. 17—20. [= *P. problema*, var. *deltoidea*, Reuss, Sitz. Akad., 1870, p. 33.]

— COMMUNIS, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 224, pl. xxxix, fig. 10.

— LONGICOLLIS, *Karrer*, 1870. Jahrb. k. k. geol. Reichsanstalt, vol. xx, p. 181, pl. xi, fig. 11.

— GRAVIS, *Karrer*, 1870. Ibid., p. 181, pl. xi, fig. 12.

— COMMUNIS, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.

— — *B. and R.*, 1875. Rep. Brit. Assoc. for 1874, p. 190.

— PROBLEMA, var. DELTOIDEA, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anstalt, vol. iv, p. 59, pl. viii, fig. 3.

GUTTULINA COMMUNIS, *Terquem*, 1875. Plage Dunkerque, p. 37, pl. v, fig. 14.

— — *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 45, pl. iv (ix), fig. 15.

— CENTRATA, *Terquem*, 1878. Ibid., p. 46, pl. ix, fig. 25.

— GRAVIDA, *Terquem*, 1878. Ibid., p. 47, pl. ix, figs. 28, 29.

GLOBULINA IRREGULARIS, *Terquem*, 1878. Ibid., p. 44, pl. ix, figs. 13, 14.

POLYMORPHINA COMMUNIS, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.

GUTTULINA PONDEROSA, *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, No. 3, p. 135, pl. xiv (xxii), fig. 1.

— COMMUNIS, *Terquem*, 1882. Ibid., p. 134, pl. xiii (xxi), figs. 40—42.

POLYMORPHINA COMMUNIS, *Brady*, 1884. 'Chall.' Rep., p. 568, pl. lxxii, fig. 19.

— (GUTTULINA) PROBLEMA, var. DELTOIDEA, *Andreae*, 1884. Abhandl. geol. Special-Karte Elsass-Loth., vol. ii, pp. 210, 233, pl. ix, fig. 21.

— — COMMUNIS, *Basset*, 1885. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 161, fig. 62.

— GLOMERATA, *Beissel* (after *Roemer* and *Reuss*), 1891. Abhandl. K. Preuss. Landesanst., n. s., pt. 3, p. 62, pl. xii, figs. 17—20 (and variety, figs. 21—29).

— GIBBA, "near COMMUNIS," *Goës*, 1894. K. Svenska Vet.-Ak. Handl., vol. xxv, No. 9, p. 55, pl. ix, figs. 523, 524.

— COMMUNIS, *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 13, pl. ii fig. 15.

Characters.—Shell ovate, acuminate anteriorly and rounded behind; somewhat compressed, with one face more convex than the other; four unequal chambers, rather gibbose, one overlapping another obliquely.

Occurrence.—Polymorphina communis (including *P. problema*) is essentially a shallow-water form, the greatest depth at which it has been observed being 155 fathoms (Brady). Its geographical range is almost world-wide.

As a fossil it has been found in the Lower Lias; the Neocomian (Bargate beds of Surrey); the Gault of Folkestone; the Red Chalk; the Oligocene of Elsass and Pietzpuhl, the Miocene of Vienna and Muddy Creek (Victoria); the Pliocene of Antwerp, Garrucha (Spain), and St. Erth. In the Coralline Crag we have specimens from every zone examined.

11. Polymorphina problema, *d'Orbigny*, 1826. Plate I, fig. 64; Plate V, fig. 23; Plate VI, figs. 12 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 51.

Polymorphina (Guttulina) problema, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vi, p. 266, No. 14; Modèle No. 61.
— crassatina, *Römer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii, fig. 30.
— spicæformis, *Römer*, 1838. Ibid., p. 386, pl. iii, fig. 31.
Guttulina problema, *Reuss*, 1846. In Geinitz's Grundriss, &c., p. 669, pl. xxiv, fig. 83.
— — *d'Orb.*, 1846. For. foss. Vien., p. 224, pl. xii, figs. 26—28.
— Austriaca, *d'Orb.*, 1846. Ibid., p. 223, pl. xii, figs. 23—25.
Polymorphina problema, *Egger*, 1857. Neues Jahrb., &c., 1857, p. 287, pl. x, figs. 23—25.
— uvula, *Egger*, 1857. Ibid., p. 285, pl. x, figs. 26—29.
Guttulina rotundata, *Reuss*, 1864. Sitz. k. Ak. Wiss. Wien, vol. l, p. 469, pl. iii, fig. 4.
— insignis, *Reuss*, 1864. Ibid., p. 470, pl. iv, fig. 4.
— problema, *Reuss*, 1864. Ibid., p. 470, pl. v, fig. 5.
Polymorphina septata, *Terquem*, 1864. 4e Mém. Foram. Lias, p. 301, pl. xiii, fig. 40.
Guttulina pusilla, *Stache*, 1865. Novara-Reise, Geol. Th., vol. i, p. 264, pl. xxiv, fig. 12.
Polymorphina problema, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 28, pl. ii, fig. 50.
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append. i and ii, pl. i, fig. 64.
— — *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 225, pl. xxxix, fig. 11.
Guttulina intricata, *Terquem*, 1874. Foram. Syst. Oolithique, p. 311, pl. xxxiii, fig. 30.
Polymorphina acuta, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anstalt, vol. iv, p. 60, pl. viii, fig. 4.

Polymorphina problema, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii, fig. 33.
— distincta, *Blake*, 1876. Ibid., p. 471, pl. xvii, fig. 35.
Guttulina Austriaca, *Terquem*, 1876. Dunkerque, p. 78, pl. x, figs. 13—17.
— problema, *Terquem*, 1876. Ibid., p. 79, pl. x, fig. 18.
— racemosa, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 46, pl. iv (ix), figs. 20—23.
— bulloides, *Terquem*, 1878. Ibid., p. 47, pl. iv (ix), fig. 27.
— Austriaca, var. angusta, *Terquem*, 1881. Plage Dunkerque, p. 130, pl. xvii, fig. 5.
— — — ovalis, *Terquem*, 1881. Ibid., p. 131, pl. xvii, fig. 6.
— — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 133, pl. xxi, fig. 36.
— mucronata, *Terquem*, 1882. Ibid., figs. 38, 39.
— problema, *Terquem*, 1882. Ibid., p. 134, pl. xxi, figs. 43, 44.
Polymorphina problema, *Brady*, 1884. 'Challenger' Rept., p. 568, pl. lxxii, fig. 20; pl. lxxiii, fig. 1.
— (Guttulina) problema, *Basset*, 1885. Ann. Soc. Sci. N. Char.-Inf., No. 21, p. 161, fig. 61.
Bulimina pyrula (part), *A. Silvestri*, 1893. Atti Rend. Acc. Acireale, vol. v, p. 10, pl. v, figs. 79, 80.
Polymorphina problema, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 56.

Characters.—Shell oblong-ovate, irregular. Chambers numerous, much inflated, and separated by deep sutures; sometimes arranged triserially, but more frequently crowded together irregularly.

D'Orbigny's Modèle No. 61 forms a convenient subtype, embracing a large group of *Polymorphinæ*, which have in common a somewhat acervuline mode of growth, and but little adhesion or overlap amongst the segments. His later figures of the same species are by no means so characteristic, and are scarcely separable from *P. communis;* of which, indeed, we consider *P. problema* to be a wild-growing modification.

Occurrence.—For the occurrence of this *Polymorphina*, which is intimately allied to *P. communis*, see the notes on the latter at page 267.

12. Polymorphina turgida, *Reuss*, 1855. Plate V, fig. 25.

Guttulina turgida, *Reuss*, 1855. Sitzungsb. k. Akad. Wiss. Wien, vol. xviii, p. 246, pl. vi, fig. 66.
Polymorphina (Guttulina) turgida, *Reuss*, 1866. Denksch. k. Akad. Wiss. Wien, vol. xxv, p. 153, No. 11.
Guttulina, No. 438 and No. 441, *Schlicht*, 1870. Pietzpuhl, p. 77, pl. xxviii, figs. 6—10; and pl. xxix, figs. 1—5.

Polymorphina turgida, *Reuss*, 1870. Sitzungsb. k. Akad. Wiss. Wien, vol. lxii, I Abtheil., p. 487, No. 10. (After Schlicht's figures.)

Characters.—Shell subrotund, rounded-oblong in outline, being nearly equally rounded at the ends, with almost straight parallel sides. Both in vertical and transverse section it is compressed and bluntly oval (shortest in the latter); chambers four (?), oblique, gibbose, and closely set with indistinct septal lines.

Reuss's fig. 66 in pl. vi (1855), closely resembles this compact *Polymorphina*, except in being more oval. Fig. 9 in Schlicht's pl. xxviii, and fig. 2 in pl. xxix, are more circular in transverse section, but otherwise express the subrotund form of our specimen. Taken altogether, the *Polymorphina* under notice is certainly within the probable range of variation of *P. turgida*, Reuss.

P. (*globulina*) *globosa*, von Münster, described and figured by F. A. Römer in the 'Neues Jahrbuch,' &c., 1838, p. 386, pl. iii, fig. 33, evidently belongs to the same group as the above. It is "nearly round, smooth, with scarcely distinguishable chambers," and is slightly compressed.

P. rotundata, Bornemann (1855, 'Zeitsch. Deutsch. Geol. Ges.,' vol. vii, p. 346, pl. xviii, fig. 3, copied in the 'Trans. Linn. Soc.,' vol. xxvii, p. 234, woodcuts, figs. *k*, *l*, *m*), is a long-oval form, closely allied to the foregoing.

An obovate variety is recognised in the 'Challenger' Report, p. 570, pl. lxxiii, figs. 5—8. Other varieties are shown by Dr. A. Goës, 'K. Svensk. Akad. Handl.,' vol. xxv, No. 9, p. 57, pl. ix, figs. 529—534.

Polymorphina solidula, Terquem, 'Mém. Soc. Géol. France,' ser. 3, vol. i, Mém. 3, 1878, p. 40, pl. iii (viii), figs. 31 *a*, *b*, is another member of the same group of compact, subrotund, compressed forms.

Occurrence.—*P. turgida* comes from the Oligocene Septaria-clays of Germany, and *P. globosa* also from the younger Tertiaries of Northern Germany. The figured specimen (Pl. V, fig. 25), from the Crag of Sutton, is in the British Museum.

P. rotundata, mentioned above as a closely allied form, is not common in the recent condition. It has been found, according to the 'Challenger' Report, off the western coast of Scotland, and off the north-east of Ireland; in the Mediterranean off Malta; off Prince-Edward Island, Southern Ocean (50 to 150 fathoms); at one station in the North Pacific (1850 fathoms); and in the South Pacific (1825 fathoms). Dr. Goës has it among the Arctic Foraminifera.

Fossil specimens have been recorded from the Oligocene (Septaria-clays) of Hermsdorf and Pietzpuhl, and from the Miocene of Kostej in the Banat, Hungary.

13. POLYMORPHINA COMPLANATA, *d'Orbigny*, 1846. Plate I, figs. 52, 53, 60.

Part I, 1866, Appendix I, Table, No. 52; Appendix II, Table, No. 53.

POLYMORPHINA CAMPANULATA, *Römer*, 1838. Neues Jahrb., &c., p. 385, pl. iii, fig. 22.
— OBSCURA, *Römer*, 1838. Ibid., fig. 23.
— TERETIUSCULA, *Römer*, 1838. Ibid., fig. 24.
— LINGUA, *Römer*, 1838. Ibid., fig. 25.
— COMPLANATA, *d'Orb.*, 1846. For. foss. Vien., p. 234, pl. xiii, figs. 25—30.
— PHILIPPII, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 248, pl. vii, fig. 76.
— LINGUA, *Reuss*, 1855. Ibid., fig. 77.
— COMPLANATA, *Mackie*, 1859. Rec. Sci., i, p. 148, fig. 24.
— — *Reuss and Fritsch*, 1861. Model No. 67, Catal. 1861; No. 72, Catal. 1865.
— SUBRHOMBICA, *Reuss*, 1861. Sitz. k. Acad. Wiss. Wien, vol. xliv, p. 339, pl. vii, fig. 3.
— OBSCURA, *Reuss*, 1864. Ibid., vol. l, p. 471, pl. iii, figs. 8—10.
— COMPLANATA, *Jones, Parker, and Brady*, 1866. Monog. Foram. Crag, pl. i, figs. 52, 53, 60.
— — *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 230, pl. xl, figs. 14 *a*, *b*, and woodcuts *f* to *j*.
— FISCHERI (?), *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 41, pl. 3 (viii), figs. 38 *a—c*.
— SPATULATA, *Terquem*, 1882. Ibid., vol. ii, No. 3, p. 142, pl. xiv, (xxii), fig. 32.
— COMPLANATA, *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 84, pl. iv, fig. 9.
— — *Gümbel*, 1885. Geol. Bayern., 1 Theil, 2 Lief., p. 421, fig. 266_{15}.
— — *Beissel*, 1891. Abhandl. K. Preuss. geol. Landes., n. s., pt. 3, p. 58, pl. x, figs. 48—53.

Characters.—Shell much compressed, elongate, or subrhomboidal. Chambers elongate, oblique, arranged in two regularly alternating series. Septal lines slightly excavated.

Note.—The name "*complanata*" given by d'Orbigny, though later than some others, has been adopted because of the good figure of the type.

Occurrence.—*Polymorphina complanata* is rare in the recent condition (coast of Galway). As a fossil it has been recorded from the Chalk of Maestricht;

from the Miocene of Vienna; and from the Upper Tertiaries of north-west Germany. We have specimens from the Casterlian of Antwerp; and Mr. Millett has recorded it from the Pliocene of St. Erth. In the Coralline Crag we have found it in every zone examined.

14. POLYMORPHINA FRONDIFORMIS, *Searles Wood*, 1843. Plate I, figs. 62, 63, 69 (var.); Plate IV, figs. 11—14; Plate VII, fig. 20 (var.).

Part I, 1866, Appendices I and II, footnotes.

POLYMORPHINA FRONDIFORMIS, *Searles Wood*, 1843. In Morris's Catalogue of British Fossils, p. 62.
— — *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices i and ii (footnotes), pl. i, figs. 62, 63 (not 69); pl. iv, figs. 11—14.
— — *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 241, pl. xli, figs. 33 *a—c*.

Characters.—Shell large, elongate, compressed or complanate, unsymmetrical. Chambers long, oblique, irregular. Surface depressed over portions of the septal lines; sometimes smooth, but more frequently marked by exogenous shell-growths, either in the form of rounded beads or short, interrupted costæ.

This form is related to *P. complanata* (megalospheric ?), but peculiar in its habit and locality. The ornamentation is very peculiar, and does not exactly correspond with what is seen in allied genera. It consists (as in *P. myristiformis*) of clear, bright, circular or oval beads, or of more or less interrupted costulæ of the same sort, distributed irregularly in longitudinal direction over the flat sides of the shell.

14*. Var. BREVIS.

Pl. VII, fig. 20, illustrates a varietal form, var. *brevis*, subovate in outline, with relatively shorter and fuller chambers, ornamented chiefly near the edge with irregular and subquadrate drop-like beads, such as occur among the costulæ on other specimens.

14**. Var. LINEATA.

Pl. I, fig. 69, may be the young form of *P. frondiformis*, but is probably a small variety (var. *lineata*), more regularly ovate in outline, with its edges entire, its chambers fuller, and its surface ornamented with delicate longitudinal sculpturing, somewhat like that of *P. pulchella*, d'Orb., and still more like that of the "striato-fistulose specimen from the Crag ('Trans. Linn. Soc.,' vol. xxvii, pp. 246 and 252). This specimen seems to have been lost; and unfortunately the figure escaped notice when the new plates and woodcuts were being drawn.

Occurrence.—As far as is at present known, *Polymorphina frondiformis* is absolutely peculiar to the Coralline Crag of East Anglia. At the time of the publication of the First Part of this Monograph, it had been found at Sutton only. We have now obtained specimens, with varying frequency, from every zone examined.

15. POLYMORPHINA VARIATA, *Jones, Parker, and Brady*, 1866. Plate I, figs. 67, 68; Plate V, fig. 27.

Part I, 1866, Appendices Nos. 1 and 2, Tables, footnotes.

POLYMORPHINA VARIATA, *J., P., and B.* Monogr. Foram. Crag, Appendices i and ii, footnotes; pl. i, figs. 67, 68; pl. v, fig. 27.
— — *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 237, pl. xl, fig. 24.

Characters.— Shell suboblong, compressed, asymmetrical, few-chambered. Margin rounded, somewhat constricted at the septal lines. Chambers slightly inflated. Surface uneven, studded with irregular angular depressions imparting a mottled appearance to the whole exterior. Orifice variable; simple or labyrinthic.

These large *Polymorphinæ* from the Crag have a surface-ornamentation that has not been observed in specimens from other localities. It consists of unequal, irregular, angular depressions, sometimes bordered by a slightly raised line. The shell-wall is coarse and thick; and the terminal orifice sometimes differs from the normal circular aperture, becoming labyrinthic, or even divided into two or three distinct perforations.

Occurrence.—*Polymorphina variata*, like *P. frondiformis*, appears to be confined to the Coralline Crag of East Anglia. It has been found in every zone we have examined; but most plentifully at Sutton (zone **f**), and Sudbourne Hall (zone **d**).

16. Polymorphina tuberculata, *d'Orbigny*, 1846. Plate V, fig. 29.

Globulina tuberculata, *d'Orb.*, 1846. Foram. Foss. Vien., p. 230, pl. xiii, figs. 21, 22.
Polymorphina (Globulina) tuberculata, *Egger*, 1857. Neues Jahrb. &c., Jahrg., 1857, p. 292, pl. xiv, figs. 7, 8.
Globulina tuberculata, *Reuss*, 1862. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 79.
Polymorphina tuberculata, *Karrer*, 1868. Ibid., vol. lviii, p. 173.
— — *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc. vol. xxvii, p. 242, pl. xli, figs. 35 *a—d*.

Characters.—Shell subovate; extremities sometimes subacute; surface beset with tubercles, unequal and irregular; septa obscure.

Occurrence.—*Polymorphina tuberculata* has apparently not been recorded in a recent condition. Fossil specimens have been found in the Gault of North Germany; in the Miocene of Vienna (d'Orbigny), Lower Bavaria (Egger), and Kostej in the Banat (Karrer); also in the Casterlian of Antwerp.

The figured specimen is from the Coralline Crag, probably of Sutton.

17. Polymorphina hirsuta, *Brady, Parker, and Jones*, 1870. Plate VI, figs. 14 *a, b*.

Part I, 1866 ("*P. rugosa*"), Appendix I, Table, No. 56; App. II, Table, No. 52.

Polymorphina hirsuta, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 243, pl. xlii, fig. 37.
— — *Reuss*, 1870. Sitz. k. Akad. Wiss. Wien, vol. lxii, p. 486, No. 8; after *Schlicht's* No. 510 (a fistulose specimen, p. 88), pl. xxxiv, figs. 1—3.

Characters.—Shell gibbous, subspherical, or ovate. Septa obscure. Surface beset with short bristles. This acerose ornament is common among some of the *Nodosarinæ*, but rare in their allies the *Polymorphinæ*.

Occurrence.—The only recent occurrence of this species is apparently that mentioned in the "Monograph on the genus *Polymorphina*," by Brady, Parker, and Jones, namely from the West Indies.

Fossil specimens seem to be rare. The records are from the Oligocene of

Pietzpuhl; the Pliocene of St. Erth, and the Coralline Crag. We have specimens from Sudbourne Hall, zone **d**; Broom Hill, zones **d** and **e**; Sutton, zones **e** and **f**; and Gedgrave, zone **f.**

17*. Note on POLYMORPHINA RUGOSA (Part I, Appendices I and II, see above).

It is quite possible that *P. rugosa* had been noticed in the collections from the Crag, but lost sight of; and that the *P. hirsuta* subsequently observed may be quite distinct from the formerly recorded specimen of *P. rugosa*. A figure of the latter is therefore given here, since it may have occurred, and may be found again in the Crag.

FIG. 23.—*Polymorphina rugosa,* d'Orbigny. In the 'Trans. Linn. Soc.,' vol. xxvii, pl. xl, fig. 23*a*. × 12 diam.

In the 'Trans. Linn. Soc.,' vol. xxvii, 1870, p. 237, it is described as having its surface variously pitted and granular; and it is said to have been met with in shore-sand from Cuba and Martinique, and in some Tertiary deposits.

Genus 2.—DIMORPHINA, *d'Orbigny,* 1826.

Brady, Challenger Report, 1884, *p.* 70.

ORTHOCERAS, *Soldani.*
DIMORPHINA, *d'Orbigny, Sander Rang, Menke, von Reuss, Parker, Jones, Brady, Schwager, Karrer, von Schlicht, Buvignier, von Hantken, Costa, Alth, Brown, Ehrenberg, Basset, von Zittel,* and others.

General Characters.—Early chambers obscurely triserial (Polymorphine); later chambers uniserial (Nodosarian). Orifice at the summit of the terminal chamber.

1. DIMORPHINA TUBEROSA, *d'Orbigny*, 1826. Plate I, fig. 61; Plate VII, fig. 21.

Part I, Appendices Nos. I and II, Tables, No. 57 ("*D. nodosaria*," part).

Orthoceras tuberosum, *Soldani,* 1791. Testaceograph., &c., vol. i, pt. 2, p. 99, pl. cvi, fig. *gg*.

Dimorphina tuberosa, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 264, No. 1; Modèle, No. 60.
— nodosaria, *d'Orb.*, 1846. Foram. Foss. Vien, p. 221, pl. xii, figs. 21, 22.
Glandulina deformis, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 129, pl. xi, figs. 16—18, 26.
Dimorphina tuberosa, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 28, pl. ii, fig. 53.
— nodosaria (part), *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices, No. 57 (part), pl. i, fig. 61 (not fig. 66).
— tuberosa, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 249, pl. xlii, figs. 39 *a, b*.
— — *Basset*, 1885. Ann. Soc. Sci. Char.-Inf., p. 161, fig. 60.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 204, No. 231.
— deformis, *Fornasini*, 1890. Mem. Accad. Sci. Bologna, ser. 4, vol. x, p. 471, pl. o, figs. 35—37.
— tuberosa, *Fornasini*, 1891. Foram. Plioc. Pontic. Sav. Bologna, pl. ii, fig. 25.
— — *De Amicis*, 1895. Naturalista Siciliano, Ann. xiv, pp. 46 and 63.
— deformis, *De Amicis*, 1895. Ibid., pp. 47 and 63.

Characters.—Shell elongate, subcylindrical, straight, or nearly so. Anterior portion acuminate; posterior obtuse, and rounded. Early (alternating) chambers varying greatly in their proportion to the whole shell. Later (uniserial) chambers two to six in number, more or less inflated.

As explained in the "Monograph of the Genus *Polymorphina*," 1870, p. 249, there is no essential difference between d'Orbigny's *Dimorphina tuberosa* and his symmetrical *D. nodosaria*. So also *D. deformis* (Costa) appears to differ only in degree, by irregularity of growth, from *D. tuberosa*; and our fig. 21 of Pl. VII is within the varietal limits of the same species, though more even and fusiform in shape.

Taking the subcylindrical *Polymorphinæ* of the Crag as a group, we see that Pl. I, figs. 55—58 represent a type; Pl. I, fig. 61, is a tuberose subtype; Pl. VII, fig. 21, is less tuberose and more fusiform; whilst Pl. VII, fig. 17, is compressed and almost Marginuline in growth, with an eccentric beginning and uniserial upgrowth; and Pl. I, fig. 66, is still more compact and like a *Marginulina* in outline. The two latter forms are described under a separate trivial name.

A compressed form, very close to *D. tuberosa*, has been found in the Pliocene beds at St. Erth, by Mr. Millett.

Occurrence.—*Dimorphina tuberosa* is of rare occurrence both in the recent and fossil condition. Living specimens have been obtained from the Mediterranean at

depths not exceeding 100 fathoms. Fossil specimens have come from the Oligocene of Hermsdorf; Miocene of Vienna and Italy; and from the Pliocene of Garrucha, in Spain.

In addition to the figured specimen (Pl. I, fig. 61) from Sutton, we have found well-developed specimens from the same place in zone **f**.

2. Dimorphina compacta, *Brady*, *Parker*, and *Jones*, 1870. Plate I, fig. 66 ("*D. tuberosa*"); Plate VII, fig. 17.

Part I, 1866, Appendices No. I and No. II, Tables, No. 58 ("*D. tuberosa*").

Dimorphina tuberosa, *J.*, *P.*, *and B.*, 1866. Monogr. Foram. Crag, Appendices, No. 58, pl. i, fig. 66.
— compacta, *B.*, *P.*, *and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 250, pl. xlii, fig. 41.

Characters.—Shell elongate, subcylindrical, more or less arcuate, compactly built; anterior extremity obtuse or truncate; posterior rounded. Margin even; septa marked by faint lines.

Fig. 66, Pl. I, the specimen described in the "Monograph of Polymorphina," 1870, was separate from *D. tuberosa* on account of its marginuline form with compressed oblique uniserial chambers. Fig. 17, Pl. VII, also has a quasi-marginuline style of growth; and, although it is not so elongate and narrow as the other, its general outline and compact structure show its close alliance.

D. compacta, but having a slit-like aperture, has been met with by Mr. F. W. Millett at St. Erth. Moreover, a compressed Dimorphine *Polymorphina* has been found by Mr. Millett in these Pliocene beds, and described and figured by him in the 'Trans. Roy. Geol. Soc.,' Cornwall, vol, xi, part 9, 1895, p. 658, pl. o, figs. 5, 6 *a*, *b*, as *Polymorphina regularis*, var. *parallela*.

Occurrence.—*Dimorphina compacta* is not known in the recent condition. Excepting the above notice of its occurrence at St. Erth, the only record of its having been found is from the Coralline Crag of Sutton, whence both of our figured specimens were obtained.

Genus 3—Uvigerina, *d'Orbigny*, 1826.

Brady, 'Challenger' Report, pages 682, 702.

Uvigerina, *d'Orbigny, Sander Rang, Menke, Bronn, Czjzek, Reuss, Parker and Jones, Williamson, Morris and Quekett, Carpenter, Seguenza, Karrer, Brady, Stache, Schwager, Gümbel, Sars, Alcock, Parfitt, G. M. Dawson, Terquem, Terrigi, Sherborn, Chapman, Toutkowski, Goës, Ehrenberg, Fornasini, Woodward and Thomas, Marsson, von Hantken, Costa, Macdonald, Cuvier, Mackie, Zittel, Vine, Hoernes, Basset, Quenstedt, Egger, Mariani, Pictet, Suess, Millett, and others.*

General Characters.—Shell free, elongate, fusiform, obscurely spiral. Segments numerous; convex, or angular on their free surfaces. Aperture simple, central, in the tubular prolongation of the terminal chamber. See also Carpenter's 'Introd. Study Foram.,' 1862, p. 169.

1. Uvigerina angulosa, *Williamson*, 1858. Plate VII, fig. 26.

Uvigerina pygmæa, *Parker and Jones*, 1857. Ann. Mag. N. H., ser. 2, vol. xix, p. 297, pl. xi, figs. 41 and 43.
— angulosa, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 67, pl. v, fig. 140.
— trigona, *Seguenza*, 1862. Atti Accad. Gioenia, ser. 2, vol. xviii, pp. 110, 123, pl. ii, figs. 1, 1 *a*.
— pygmæa, var. angulosa, *P. and J.*, 1865. Phil. Trans., vol. cli, p. 364, pl. xiii, fig. 58; pl. xvii, figs. 66 *a*, 66 *b*.
— cristata, *Marsson*, 1878. Mitth. Nat. Ver. Neu-Vorpommern und Rügen, Jahrg. x, p. 150, pl. iii, figs. 20 *a*—*d*.
— angulosa, *Seguenza*, 1880. Atti Accad. Linc., ser. 3, vol. vi, pp. 226 and 307.
— — *Bütschli*, 1880. Bronn's Klassen, &c., p. 200, pl. vii, fig. 31.
— — *Brady*, 1884. Report 'Challenger,' p. 576, pl. lxxiv, figs. 15—18.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. ii, p. 314, pl. ix, figs. 40, 46, 47.

UVIGERINA ANGULOSA, *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 51, pl. ix, figs. 502—509.
— — *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 48 and 63.

Characters.—Shell subovate in outline, with sharp ends; triangular in cross-section. Chambers obscurely spiral and alternately angular, so that the shell has a nearly continuous ridge on each of its three faces. Surface of shell sometimes bearing irregular, longitudinal costulæ or wrinkles.

Of the drawings given by Dr. Brady, his fig. 18 most nearly corresponds with our fig. 26.

Occurrence.—*Uvigerina angulosa* has been found in almost all seas at depths ranging from 2 to 1630 fathoms ('Challenger') and 2328 fathoms ('Gazelle').

Fossils specimens have been recorded from the Miocene of Malaga and Italy; the Pliocene of Italy, St. Erth, and Antwerp (Casterlian). In the Coralline Crag we have specimens from nearly every zone examined.

2. UVIGERINA CANARIENSIS, *d'Orb.*, 1839; var. FARINOSA, *von Hantken*, 1875. Plate VII, fig. 27.

Part I, 1866, Appendix II, Tables, No. 73.

Testæ pineiformes minusculæ, *Soldani*, 1798. Testaceographia, &c., vol. ii, p. 18, pl. iv, figs. G, H (E, F correspond to *U. Canariensis*).
UVIGERINA NODOSA, var. *β*, *d'Orb.*, 1826. Ann. Sci. Nat., voi. vii, p. 269, No. 2.
— CANARIENSIS, *d'Orb.*, 1839. Foram. Canaries, p. 138, pl. i, figs. 25—27.
— IRREGULARIS, *Brady*, 1865. Nat. Hist. Trans. Northumberland and Durham, vol. i, p. 100, pl. xii, fig. 5.
— — — 1870. Ann. Mag. Nat. Hist., 4 ser., vol. vi, pp. 297, 306.
— FARINOSA, *Hantken* (1875), 1881. Mittheil. Jahrb. k. Ung. geol. Anstalt, vol. iv, p. 62, pl. vii, fig. 6.
— CANARIENSIS, *Brady*, 1884. Rep. 'Challenger,' p. 573, pl. lxxiv, figs. 1—3.

Characters.—Shell ovato-acuminate. Chambers irregular, subconvex. Surface smooth.

There are intermediate forms between *U. farinosa* and *U. Canariensis*; but the former is sufficiently distinct to be retained as a variety. It may be said to have

much the same relationship to *U. Canariensis* as *U. tenuistriata* has to *U. pygmæa*.

Occurrence.—The typical *Uvigerina Canariensis* has a wide geographical and bathymetrical range. The 'Challenger' records as to depth vary from shore-sands to 1900 fathoms; and the specimens were obtained from several widely separated stations in the North and South Atlantic, and in the South Pacific.

Egger, in his Memoir on the Foraminifera obtained by the 'Gazelle,' records specimens from off the coasts of Mauritius, Western Australia, and New Guinea.

We have specimens in our own collections from soundings obtained by H.M.S. 'Penguin' from two stations in the Indian Ocean, one of them due south of Ceylon, at depths of 1040 and 1277 fathoms respectively.

In the fossil condition specimens have been obtained from the Chalk of Taplow; the Miocene of Vienna and Muddy Creek (Victoria), and the Pliocene of Kar Nicobar. In the Coralline Crag we have specimens from Tattingstone, zone **d**; Sutton, zone **e**; and Gedgrave, zone **f**. In the First Part of this Monograph, *U. Canariensis* ("*U. irregularis*") was recorded from the Red Crag (Appendix I, Table, No. 59; App. II, Table, No. 73); but the specimen has been lost. Var. *farinosa* (Hantken) is from the Tertiary of Hungary.

Family 4.—GLOBIGERINIDÆ.

General Characters.—Test free, calcareous, perforate; chambers few, inflated, arranged spirally; aperture simple or multiple, conspicuous. No supplementary skeleton nor canal-system. Some of the larger forms pelagic in habit.

Genus 1—Globigerina, *d'Orbigny*, 1826.

Echinus, *Walker and Jacob.*

Polymorphum, Sphærula, &c., *Soldani.*

Globigerina, *d'Orbigny, Sander Rang, Menke, Bronn, Reuss, Brown, Ehrenberg, Bornemann, Parker and Jones, Egger, Williamson, Morris and Quekett, Carpenter, Seguenza, Karrer, Wallich, Brady, Costa, Gümbel, Alcock, Parfitt, G. Dawson, Römer, Bailey, Pourtales, S. Owen, Schwager, Hogg, Terquem, Wright, Stache, von Hantken, Terrigi, Cuvier, Pictet, Mackie, Suess, Kübler and Zwingli, Chapman, Thomson, Toula, Vanden Broeck, Hertwig, Hopkins, Nicholson, Bütschli, Goës, Andreae, Basset, Woodward and Thomas, Quenstedt, Sherborn, Malagoli, A. Agassiz, Steinmann,*

Mariani, von Hagenow, Mantell, Beudant, Hitchcock, Cooke, Toutkowsky, Fritel, Prestwich, Fric, Brandt, Hoernes, Gosse, Balkwill, Millett, Berthelin, Miller, Fornasini, Dunikowski, Chimmo, Sorby, Huxley. Macdonald, Schlicht, Ansted, Neumayr, Moseley, Schacko, De Amicis, Dervieux, Deshayes, Silvestri, Ciofalo, Cafici, Neviani, Sacco, Corti, Schrodt, Guppy, and others.

ALLOTHECA (?), ARISTEROSPIRA, HEMISTEREA (?), HEMISTICTA PHANEROSTOMUM, PLANULINA, POROSPIRA, PTYGOSTOMUM, PYLODEXIA, *Ehrenberg.*

RHYNCHOSPIRA (?), *Ehrenberg*, *Reuss* (MS.), *Karrer.*

ROSALINA, *d'Orbigny*, *Ehrenberg*, *Reuss*, *Jones.*

ROTALIA, *Ehrenberg*, *Kübler*, and *Zwingli.*

ROTALINA, *Seguenza.*

General Characters.—Shell free, coarsely perforate, planospiral, trochoid, rotaliform, or agglomerate; chambers few, inflated, arranged more or less on a spiral plan. Aperture large at the umbilical face of the chambers.

Probably no single type of recent Foraminifera has attracted as large an amount of attention as *Globigerina*, partly from its exceedingly wide distribution and its extraordinary abundance, but more from the interesting questions of life-history, and even of physical geography, which are associated with its occurrence.

The type appears to admit of some amount of variation in external characters, though these exist within narrower limits than is often the case; the differentiation from the central form being chiefly in respect to the greater or less regularity in mode of growth, the number and sphericity of the segments, and the varying condition of the surface and texture of the shell.

Whilst conscious that the whole of the modifications arising in these ways may be connected in unbroken series with the central form, and consequently that there is no ground for *specific* subdivision in any right sense, we are bound to admit the convenience of recognising the names applied by various authors to the more prominent and best-marked forms, and to accord to them a certain subspecific or varietal value.

1. GLOBIGERINA BULLOIDES, *d'Orbigny*, 1826. Plate II, figs. 1, 2.

Part I, 1866, Appendix I, Table, No. 61; II, Table, No. 59.

Polymorpha, *Tuberosa* et *Globulifera*, *Soldani*, 1791. Testaceographiæ, &c., vol. i, pt. 2, p. 117, pl. cxxiii, figs. H, I, L, N, O, P; pl. cxxiv, all the figs. except *Z*; pl. cxxv; and half of the figs. in pl. xxxi.

Sphærulæ, Testæ *tuberosæ* ac *globuliferæ*, *Soldani*, 1798. Ibid., vol. ii, p. 20, pl. vi, figs. *dd*, *ee*.

GLOBIGERINA BULLOIDES, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 277, No. 1; Modèles, No. 17 (young) and No. 76.

— — (*Giroidina* in the text), *Cuvier*, 1829–43. *Guérin-Meneville*, Iconographie, Mollusques, p. 9, pl. ii, fig. 12.

— — *Cuvier*, 1831–37. Henderson's Anim. Kingd., ed. 3, p. 18, pl. iii, fig. 12.

— — *Deshayes*, 1830. Vers. Encycl. Méth., vol. ii, p. 170.

— — *Roemer*, 1838. N. Jahrb., &c., p. 390, pl. iii, fig. 42 *a*.

— — *d'Orbigny*, 1839. Foram. Amér. Mérid., p. 37.

— — *d'Orbigny*, 1839. Foram. Canaries, p. 132, pl. ii, figs. 1—3, 28.

— HIRSUTA, *d'Orbigny*, 1839. Ibid., p. 133, pl. ii, figs. 4—6.

— SIPHONIFERA, *d'Orbigny*, 1840. Foram. Cuba (Spanish edit.), p. 95, pl. iv, figs. 15—18.

— BULLOIDES, *d'Orbigny*, 1846. For. Foss. Vien., p. 163, pl. ix, figs. 4—6.

— — *Pictet*, 1846. Traité Paléont., iv, p. 232, pl. xii, fig. 16; edit. 2, 1857, p. 509, pl. cix, fig. 29.

— CONCINNA, *Reuss*, 1849. Denkschr. k. Akad. Wiss. Wien, vol. i, p. 373, pl. xlvii, fig. 8.

— DIPLOSTOMA, *Reuss*, 1849. Ibid., p. 373, pl. xlvii, figs. 9, 10; pl. xlviii, fig. 1.

— BULLOIDES, *Bronn*, 1835—56. Leth. Geogn., ed. 3, iii, p. 228, pl. xxxv[2], figs. 19 *a—c*.

— DEPRESSA, *Ehrenberg*, 1854. Mikrogeologie, pl. xix, fig. 92.

— FOVEOLATA (pars), *Ehrenberg*, 1854. Ibid., pl. xxii, fig. 74.

— CRETÆ, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 44; pl. xxx, fig. 38.

— STELLATA, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 45.

— TERNATA, *Ehrenberg*, 1854. Ibid., pl. xxxv B, figs. 5, 6.

PLANULINA POROTETRAS, *Ehrenberg*, 1854. Ibid., pl. xx, ii, fig. 16.

— PERTUSA, *Ehrenberg*, 1854. Ibid., pl. xxii, fig. 75.

— STIGMA, *Ehrenberg*, 1854. Ibid., pl. xxv, fig. 29.

ROTALIA RUDIS, *Ehrenberg*, 1854. Ibid., pl. xxiv, figs. 35, 36.

— LEPTOSPIRA, *Ehrenberg*, 1854. Ibid., fig. 39.

— SENARIA (pars.), *Ehrenberg*, 1854. Ibid., fig. 40.

PTYGOSTOMUM ORPHEI, *Ehrenberg*, 1854. Ibid., pl. xxxv B, figs. 1, 2.

PHANEROSTOMUM ATLANTICUM, *Ehrenberg*, 1854. Ibid., figs. 3, 4.

GLOBIGERINA BULLOIDES, *Costa*, 1856. Atti Accad. Pontan., vol. vii, part 2, p. 242, pl. xxi, figs. 1, 2.

— — *Egger*, 1857. N. Jahrb., &c., p. 282, pl. xi, figs. 14—16.

— — *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 291, pl. xi, figs. 11, 12.

Globigerina bulloides, *Williamson*,[1] 1858. Rec. Brit. For., p. 56, pl. v, figs. 116—118.
— — *Bronn*, 1859. Klassen, p. 70, pl. vi, figs. 9 *a—c*.
— — *Mackie*, 1859. Recreat. Sci., vol. i, p. 147, fig. 9.
— — *Suess*, 1862. Boden Stadt Wien, p. 45, fig. 1[4].
— — *Silvestri*, 1862. Atti X Congresso, &c., p. 82.
— — *Seguenza*, 1862. Atti Acc. Gioenia Sci. nat., ser. 2, vol. xviii, p. 103.
— — *Stache*, 1864. Novara-Exped. Geol., part 1, p. 286, pl. xxiv, figs. 35 *a—e*.
— — *Reuss*, 1865. Model, No. 69 (No. 91, Catal., 1861).
— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 21, pl. ii, fig. 56; p. 31, pl. ii, fig. 55.
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, App. I and II, No. 61 and No. 59, pl. ii, figs. 1, 2.
— — *Kübler and Zwingli*, 1866. Neujahrsblatt Bürgerbibl. Winterthur, pt. 2, p. 22, pl. iii, figs. 30, 31.
— taminensis, *Kubler and Zwingli*, 1866. Ibid., pp. 24, 28, pl. iii, figs. 26, 29.
— bulloides, *P. R. I., Owen*, 1868. Journ. Linn. Soc. Zool., vol. ix, p. 148, pl. v, figs. 6—9, 11, 12.
— — *Mackie*, 1867, Science Gossip, p. 130, fig. 127.
— — *Gümbel*, 1868 (1870). Abh. k. Bayer, Akad. Wiss., vol. x, p. 661, pl. ii, figs. 106 *a, b*.
— alpigena (?) *Gümbel*, 1868. Ibid., p. 661, pl. ii, fig. 107.
— eocæna, *Gümbel*, 1868. Ibid., p. 662, pl. ii, fig. 109.
— — *Anon.*, 1870. Sci. Goss., p. 12, fig. 31.
— — *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, p. 175, pl. xi, fig. 112.
Planulina Mauryana, *Ehrenberg*, 1873. Abhandl. k. Akad. Wiss., Berlin, p. 388, pl. iii, fig. 1.
— globigerina, *Ehrenberg*, 1873. Ibid., fig. 3.
— megalopentas, *Ehrenberg*, 1873. Ibid., pl. iv, fig. 7.
Pylodexia platytetras, *Ehrenberg*, 1873. Ibid., pl. iii, fig. 14.
Aristerospira omphalotetras, *Ehrenberg*, 1873. Ibid., fig. 15.
Globigerina bulloides, *Thomson*, 1873. Depths Sea, p. 22, fig. 2.
— — *Brady and Robertson*, 1875. Rep. Brit. Assoc., p. 191.
— detrita, *Terquem*, 1875. Dunkerque, p. 31, pl. iv, figs. 4 *a—c*.
— bulloides, *Terquem*, 1875. Ibid., figs. 5 and *a, b*.
— — *Toula*, 1875. Mitth. Geogr. Ges. Wien, vol. xviii, p. 165, pl. o, fig. 13.

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[1] The description includes "arenaceous" texture, perhaps referring to *Haplophragmium globigeriniforme*.

GLOBIGERINA BULLOIDES, *Thomson*, 1875. Proc. Roy. Soc., vol. xxiii, p. 34, fig. 1.
— — *Hantken*, 1875 (1881). Mitth. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, p. 69, pl. viii, fig. 2.
— — *Brady*, 1875. Ann. Mag. N. H., ser. 4, vol. vi, p. 306.
— — *Morris*, 1876. Lecture Geol. Croydon, p. 8, figs. 2^{3}, 3^{8}.
— — *Wallich*,[1] 1876. Deep-sea Researches, Biol. Globig., pp. 1—78, figs. 1–9, 11, 12, 17, 18.
— — *Anon*, 1876. Amer. Journ. Microsc., vol. i, p. 125, fig. 1.
— — *Hertwig*, 1877. Jenaische Zeitsch. Naturw., vol. xi, p. 343, pl. xx, fig. 8.
— — *Thomson*, 1877. Voyage 'Challenger,' vol. i, p. 211, fig. 46.
— — *Hopkins*, 1878–9. Report Chief Engineers, series 2, App. W. (Congress, &c.), p. 885, pl. ii, fig. 70.
— — *Ciofalo*, 1878. Atti Acc. Gioenia Sci. Nat., ser. 3, vol. xii, p. 7.
— — *Brady*, 1879. Quart. Journ. Micr. Soc., n. s., vol. xix, p. 71.
— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 99, fig. 13 *f*; p. 115, fig. 18 *k*.
— — *Bütschli*, 1880. Bronn's Klassen, p. 201, pl. viii, figs. 9 and 28.
— — *Terrigi*, 1880. Atti Accad. Pont. Nuovi Lincei, vol. xxxiii, p. 186, pl. i, fig. 17 (= *? cretacea*).
— — *Carpenter*, 1881. The Microscope, ed. 6, p. 569, figs. 325—327.
— — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 85, pl. ix (xvii), figs. 2 *a*, *b*.
— — *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, No. 4, p. 90, pl. vi, figs. 195—207 (restricted in 1894 to fig. 203).
— — *Cafici*, 1883. R. Accad. Lincei, ser. 3, vol. xiv, p. 85.
— — *Jones*, 1883. Microgr. Dict., p. 358, pl. xxiv, figs. 2, 3.
— — *Schwager*, 1883. Palæontogr., vol. xxx, p. 118, pl. xxvii (iv), figs. 5 *a*—*c*.
— — *Terquem*, 1883. 5me Mém. Foram. Oolith., p. 365, pl. xli, figs. 10 *a*, *b*.
— — *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 180; vol. iv, 1885, p. 114; vol. v, 1886, pp. 210, 211, 231, 236.
— — *Andreae*, 1884. Abh. Geol. Sp.-Kart. Elsass-Loth., vol. ii, pt. 3, p. 218, pl. ix, fig. 1, 2.
— — *Brady*, 1884. Report 'Challenger,' p. 593, pl. lxxvii; and pl. lxxix, figs. 3—7.
— — *Basset*, 1885. Ann. Char.-Inf., p. 162, figs. 17 and 76.

[1] See also his 'North-Atlantic Sea-bed,' 1862, pl. vi.

GLOBIGERINA BULLOIDES, *Woodward and Thomas*, 1885. Thirteenth Ann. Rep. Geol. N. H. Survey Minnesota, p. 172, pl. iii, fig. 13 [also 17 and 18].
— — *Gümbel*, 1885. Geol. Bayern, vol. i, pt. 2, p. 421, figs. 266^{20}.
— — *Quenstedt*, 1885, edit. 3, pt. 5, p. 1057, pl. lxxxvi, fig. 49.
— — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 8 *a*, *b*.
— — *Hogg*, 1886. Microscope, edit. 11, pl. iii, figs. 79, 81.
— — ? *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. iv, No. 2, p. 56, pl. vi (xii), fig. 24.
— OOLITHICA [?], *Terquem*, 1886. Ibid., p. 57, pl. vi (xii), figs. 25 *a*, *b*.
— BULLOIDES, *Malagoli*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 521, pl. xiii, fig. 7.
— — *Anon.* [*Chapman*], 1888. Sci. News, p. 413, fig. 16.
— — *Agassiz*, 1888. Cruises 'Blake,' vol. ii, p. 167, fig. 511.
— — *Steinmann*, 1888. Elém. Paléont., vol. i, p. 28, fig. 10.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 225, pl. xlv, fig. 15.
— — *Mariani*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 288, pl. x, figs. 14, 15.
— — *Häusler*, 1890. Abh. Schweiz. Pal. Ges., vol. xvii, p. 118, pl. xv, fig. 46.
— — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 561 pl. xi, fig. 17.
— — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 101, pl. iii, figs. 26, 27 ; pl. iv, fig. 1.
— — — 1891. Ibid., vol. iv, pt. 1, p. 101, pl. iv, fig. 26.
— — *Corti*, 1892. Rendic. R. Istit. Lombardo, ser. 2, vol. xxv, p. 13, pl. iv, fig. 10.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, Abth. ii, p 362, pl. xiii, figs. 1—4.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 435.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 83, pl. xiv, figs. 754—762.
— — *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 36, pl. iv, figs 13 *a* – *d*.
— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 51 and 63.

Characters.—Shell spiral, consisting of about two convolutions, composed of highly globular segments, which increase very rapidly in size ; the outermost convolution usually containing four segments, visible on the inferior surface, the remainder visible only on the superior surface. Orifice very large on the lower umbilical margin of the much inflated ultimate segment. Frequently the individual chambers open directly into the deep central umbilicus of the inferior surface. Our figs. 1 and 2, in Pl. II, represent a small typical *Gl. bulloides*.

Occurrence.—*Globigerina bulloides* is a cosmopolitan species, found at all depths. Its earliest recorded appearance is in the Devonian (Terquem, 'Bull. Soc. Géol. France,' ser. 3, vol. viii, 1880, p. 418, pl. xi, figs. 10 *a*—*c*); it occurs in the Jurassic (Terquem and Häusler); it is abundant in the Chalk-marl and Chalk; and it has been found in nearly all subsequent marine deposits.

It forms an important constituent of the existing sea-bed wherever the depth of water exceeds 100 fathoms. At smaller depths it is comparatively rare; but it abounds on some coasts, and chance specimens have been found in brackish shallows, and even in the rivers of the Fen districts of Lincolnshire at a distance from the open sea.

Globigerina bulloides is one of the pelagic species collected by towing nets in the open ocean, in company with two or three species of *Pulvinulina*.

It seems that the Crag sea was not very favorable to the existence of this species; small specimens, however, are found throughout the Coralline Crag, and in the Upper Crag of Southwold.

2. Globigerina Linnæana (*d'Orbigny*), 1839. Plate VII, figs. 23 *a*, *b*, *c*.

Rosalina Linnæana, *d'Orb.*, 1839. Foram. Cuba, p. 101, pl. v, figs. 10—12.
— canaliculata, *Reuss*, 1854. Denksch. k. Ak. Wiss. Wien, vol. vii, p. 70, pl. xxvi, figs. 4 *a*, *b*.
Globigerina Linnæana, *Brady*, 1884. Report 'Challenger,' p. 598, pl. lxxxii, figs. 12 *a*, *b*: pl. cxiv, figs. 21 *a*—*c*.
— — *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Microsc. Soc., p. 561, pl. xi, fig. 19.
Rotalia aspera, *Beissel* (after *Ehrenberg*[1]), 1891. Abhandl. K. Preus. Landes., n. s., pt. 3, p. 73, pl. xiv, figs. 1, 2.

Characters. — Rotaliform, compressed, slightly convex above, somewhat concave with a sunken umbilicus below; edge square and bicarinate, hence canaliculate; chambers numerous, strongly limbate; apertures opening in the umbilicus; surface rough.

Occurrence.—The only record of this species in the recent condition appears to be that of the original from the shore-sands of the Island of Cuba. It is a common Cretaceous fossil, but it does not appear to have been met with in later deposits until we found specimens in the Coralline Crag of Sudbourne and Broom Hill (both zone **d**).

[1] Beissel refers also to the 'Mikrogeologie,' pl. xxvii, figs. 57, 58, which occur among young and adult forms of *Gl. cretacea* (figs. 53—59, and perhaps 60—64) (see 'Ann. Mag. Nat. Hist.,' ser. 4, vol. ix, p. 294). These falsely appear to be marginate, owing to the translucent edges of the chambers (seen by transmitted light), as is the case with many figures in this and other plates.

Genus 2.—PULLENIA, *Parker and Jones*, 1862.

PULLENIA, *Parker and Jones, Schwager, Bütschli, Andreae, Steinmann, Seguenza, von Reuss, von Hantken, Brady, Carpenter, Terrigi, Balkwill, Wright, Hamilton, Goës, Sherborn, Chapman, Egger, von Zittel, and others.*
NONIONINA, *d'Orbigny, Czjzek, von Reuss.*

General Characters.—Regularly or obliquely nautiloid and involute; chambers slightly ventricose; perforations fine; aperture a long curved slit at the union of the last chamber with the previous convolution.

1. PULLENIA SPHÆROIDES (*d'Orbigny*), 1826. Plate II, figs. 31, 32.

Part I, 1866; Appendix I, Table, No. 62; Appendix II, Table, No. 60.

Orthocerata unilocularia vel multilocularia, &c., *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. s.
NONIONINA SPHÆROIDES, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 293, No. 1; Modèle, No. 43.
— BULLOIDES, *d'Orb.*, 1826. Ibid., No. 2.
— — — 1846. For. Foss. Vien., p. 107, pl. v, figs. 9, 10.
— QUATERNARIA, *Reuss*, 1850. Haiding. Nat. Abhandl., vol. iv, p. 34, pl. ii, fig. 13.
PULLENIA SPHÆROIDES, *Carpenter*, 1862. Introd. Foram., p. 184, pl. xii, fig. 12 ("*bulloides*" in explan. plate).
— — *P. and J.*, 1865. Phil. Trans., vol. clv, p. 368, pl. xiv, figs. 43 *a*, *b*.
— — *P., J., and B.*, 1866. Monogr. Foram. Crag, Appendices I and II, Nos. 60, 62, pl. ii, figs. 31, 32.
— — *Reuss*, 1866. Denksch. k. Ak. Wiss. Wien, vol. xxv, p. 150.
NONIONINA, Nos. 339, 340, *Schlicht*, 1870. Foram. Pietzpuhl, p. 58, pl. xx, figs. 1—4 (= PULLENIA BULLOIDES, *Reuss*, 1870. Sitz. k. Ak. Wiss. Wien, vol. xlii, p. 484).
PULLENIA BULLOIDES, *Hantken*, 1875 (1881). Mitth. Jahrb. k. Ungar. Geol. Anstalt., p. 59, pl. x, fig. 9.
— — *Zittel*, 1876. Handb. Pal., i, p. 88, fig. 25^2.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 14.
— — *Bütschli*, 1880. Bronn's Klassen, &c., p. 211, pl. ix, fig. 14.
— SPHÆROIDES, *Terrigi*, 1880. Atti Acc. Pont. Lincei, vol. xxiii, p. 189, pl. i, fig. 21.
— — *A. Hamilton*, 1881. Transact. New-Zealand Instit., p. 393, pl. xvi, fig. 15.

PULLENIA SPHÆROIDES, *Goës*, 1882. K. Sv. Ak. Handl., vol. xix, No. 4, p. 104, pl. viii, figs. 248—250.
— — *Brady*, 1884. Report 'Challenger,' p. 615, pl. lxxxiv, figs. 12, 13; p. 616, cut, fig. 18.
— BULLOIDES, *Andreae*, 1884. Abh. Geol. Sp.-Kart. Elsass-Loth., vol. ii, pt. 3, p. 206, pl. ix, fig. 23.
— — *Balkwill and Wright*, 1885. Trans. R. Irish Acad. (Sci.) pp. 348 and 362, pl. xii, figs. 28 *a*, *b*.
— — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 10 *a*, *b*.
— — *Steinmann*, 1888. Elém. Paléont., vol. i, p. 32, fig. 16.
— SPHÆROIDES, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 226, pl. xliii, figs. 21 and 24.
— — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 104, pl. iv, fig. 5.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 372, pl. xix, figs. 30, 31.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 87, pl. xiv, figs. 771, 772.
— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 17.
— — *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 39, pl. iv, figs. 21 *a*, *b*.

Characters.—Shell small, subglobular, and like *Nonionina* in shape; chambers convex, four or five in each of the three or four whorls, each of which completely invests the previous whorl. The septal face arched, narrow, and bearing the long, transverse, crescentic, slit-like aperture in the under part of the chamber. Surface smooth, and suture slightly depressed. Figs. 31, 32, in Pl. II, are fairly typical.

Occurrence.—*Pullenia sphæroides* is a cosmopolitan species; most commonly met with at depths exceeding 300 fathoms. Specimens have been found as low down as 2750 fathoms. The list of localities at which this Foraminifer has been taken are thus given in the 'Challenger' report:—Davis' Strait, Novaya Zemlya, East Coast of Norway, Faröe Channel, British Seas, Mediterranean, Red Sea, North and South Atlantic, Southern Ocean, and the South and North Pacific.

An examination of material collected by H.M.SS. 'Stork' and 'Penguin' enables us to add to the above list five stations in the Indian Ocean (1040—2694 fathoms).

The geological range of the species extends to the Cretaceous period. It has been found in the Chalk of Westphalia and Ireland, in the Eocene (London Clay), in the Oligocene of Elsass and Germany, in the Miocene of Vienna, Malaga, the Banat (Karrer), and Malta (Brady), and in the Pliocene of Italy and Garrucha.

In the Coralline Crag it has been found in nearly every zone examined. It has also been met with in the Red Crag of Essex, as noted in the First Part of this Monograph.

Family 5.—ROTALIDÆ.

General Characters.—Test calcareous, perforate; free or adherent. Typically spiral, and coiled in such a manner that all the chambers are visible on the upper surface, and only those of the last whorl on the inferior or apertural side; sometimes one face being more convex, sometimes the other. Aberrant forms evolute, outspread, acervuline, or irregular. Some of the more highly modified forms have double chamber-walls, supplemental skeleton, and a canal-system.

Sub-family 1.—Spirillininæ.

General Characters.—Test free, spiral, discoidal, non-septate. Aperture simple, the open end of the tube.

Genus 1.—Spirillina, *Ehrenberg*, 1841.

Carpenter, '*Introd. Foram.*,' 1862, *p.* 180.

Spirillina, *Ehrenberg, Parkerand Jones, Williamson, Carpenter, von Gümbel, Brady, Kübler and Zwingli, Terquem, Siddall, Berthelin, Möbius, Häusler, Egger, Schacko, and others.*
Operculina, *von Reuss.*
Cornuspira, *Schultze.*
Cyclolina, *Egger.*

1*. Spirillina vivipara, *Ehrenberg*, 1843, var. minima (*Schacko*). Plate VI, fig. 22 (var. *unilinearis*, nov., in the explanation of that plate).

Synonyms of the Type-form:

? Spirillina vivipara, *Ehrenberg*, 1843. Abhandl. k. Akad. Wiss. Berlin, vol. for 1841, p. 443, pl. iii, vii, fig. 41.
— — [?] — 1847. Ibid., vol. for 1846, p. 446, pl. ii, i, fig. 82.
Operculina punctata, *Reuss*, 1849. Denkschr. k. Akad. Wiss. Wien, vol. i, p. 370, pl. xlvi, fig. 21.

Cornuspira perforata, *Schultze*, 1854. Organ. Polythal., p. 41, pl. ii, fig. 22.
Spirillina vivipara, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 284, pl. xi, fig. 46.
Cyclolina impressa, *Egger*, 1857. Neues Jahrb. f. Min., &c., p. 304, pl. x, figs. 7, 8.
Spirillina perforata, *Williamson*, 1858. Rec. For. Gt. Br., p. 92, pl. vii, fig. 202.
— vivipara, *P. and J.*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 303, No. 86.
— — — 1865. Phil. Trans., vol. clv, p. 397, pl. xv, fig. 28.
— perforata, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manchester, vol. iv, p. 206.
— — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 74 (16 of Cat.).
— vivipara, *P. and J.*, 1872. Ann Mag. N. H., ser. 4, vol. ix, p. 221.
— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 55
— — *Möbius*, 1880. Foram. Mauritius, p. 88, pl. viii, figs. 1, 2 (a single row of pores near the outer wall on the older whorls).
— — *Brady*, 1884. Report 'Challenger,' p. 630, pl. lxxxv, figs. 1—5.
— obconica, *Brady*, 1884. Ibid., figs. 6, 7 (a medial row of pores).
— vivipara, *Balkwill and Wright*, 1885. Tr. R. I. Ac., vol. xxviii (Sci.), p. 348, pl. xii, fig. 32.
— impressa, *Gümbel*, 1885. Geol. Bayern, vol. i, part 2, p. 421, fig. 266 13.
— vivipara, *Brady*, 1887. Journ. R. Micr. Soc., p. 917.
— — *Häusler*, 1890. Abh. Schweiz. Pal. Ges., vol. xvii, p. 122, pl. xv, fig. 49.
— minima, *Schacko*, 1892. Arch. Freund. Nat. Mecklenburg, Jahr. xlv (for 1891), p. 159, pl. o, figs. 4 *a*, *b*.
— vivipara, *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 394, pl. xviii, figs. 56—58.

Characters.—In the type-form the shell is discoidal, thin, sometimes concave in the middle; rounded on the edge, the whorls being sub-cylindrical, rarely embracing, but the later usually larger in diameter than the earliest; bearing numerous conspicuous foramina.

The variety here figured differs from the type-form in being marked by a single row of impressions or perforations along the inner edge of the sub-cylindrical tubular whorls. We had prepared to call it *unilinearis*, but Dr. G. Schacko, of Berlin, has figured and described a very similar, if not identical form, as above quoted. The large perforations along the suture-line, besides the fine general perforation, are characteristic. The apparent granulation of the surface in his specimen M. Schacko attributes to a partial decalcification of the shell.

Occurrence.—*Spirillina vivipara* (with its varieties) has a world-wide distribution in comparatively shallow waters. The lowest depth from which specimens were obtained by the 'Challenger' was 620 fathoms.

Fossil specimens are comparatively rare. It has been obtained from the Miocene of Vienna and Lower Bavaria, the Pliocene of St. Erth, and the Pleistocene of Ireland. In the Coralline Crag we have specimens of the type-form or varieties from nearly every zone examined. Fig. 22 represents a specimen from Broom Hill. Dr. Schacko describes his *Sp. minima* as being abundant in the Chalk of Rugen.

1**. Spirillina vivipara, *Ehrenberg*, 1841, var. complanata, nov. Plate III, figs. 20—22.

Part I, 1866 ("*Spirillina vivipara*"), Appendices I and II, Tables, No. 75.

In figs. 20—22 we see all the characters of *Spirillina vivipara* excepting that the edge is obliquely steep,—that is, the tube, instead of being circular in section, has an obliquely oblong sectional area, and the shell is flat above and below, the sutures being quite flush with the surface, and the whorls not at all overlapping one another.

Hence we must regard this figured specimen as a variety (var. *complanata*). The oblique periphery is seen also in Brady's *Sp. inæqualis*, Rep. 'Challenger,' p. 631, pl. lxxxv, figs. 8—11.

Occurrence.—For that of the type-form see above. The figured specimen (Pl. III, figs. 20—22) was collected by Mr. S. V. Wood in the Sutton Crag.

Sub-family 2.—Rotalinæ.

Test free or, rarely, attached, somewhat ammonitiform (rotaliform), and sometimes acervuline. Aperture usually or normally a crescentic slit on the inferior face of the shell.

Genus 1.—Discorbina, *Parker and Jones*, 1862.

Carpenter, 1862, *Introd. Foram., p.* 203 ; *Brady*, 1884, *Report 'Challenger,' pp.* 72, 627, 640.

Rotalites, *Lamarck, Defrance, Blainville.*
Rotalia, *Lamarck, d'Orbigny, von Münster, Römer, Michelotti, Parker and Jones, Morris and Quekett.*
Discorbis, Discorbites, *Lamarck, Defrance, Blainville, Berthelin.*

Rotulites, *Defrance*, *Blainville*.
Rosalina, *d'Orbigny*, *Schultze*, *Parker and Jones*, *von Reuss*, *Terquem*.
Anomalina, *d'Orbigny*, *von Reuss*.
Trochulina, *d'Orbigny*.
Valvulina, *d'Orbigny*, *von Reuss*.
Asterigerina, *d'Orbigny*, *von Reuss*, *Egger*, *Costa*, *Morris and Quekett*, *Karrer*, *Terquem*.
Rotalina (pars), *von Reuss*, *Williamson*, *Alcock*, *Parfitt*, *Terquem*.
Discorbina, *Parker and Jones*, *Carpenter*, *Brady*, *von Reuss*, *M. Sars*, *Karrer*, *von Gümbel*, *Miller and Vanden Broeck*, *Schultze*, *Robertson*, *Winther*, *von Hantken*, *Siddall*, *Shone*, *Marsson*, *Wright*, *Möbius*, *Seguenza*, *Terrigi*, *Schwager*, *Macdonald*, *Goës*, *Howchin*, *Toutkowsky*, *Dawson*, *Walther*, *Uhlig*, *Olszewski*, *Balkwill*, *Wright*, *Morris*, *K. Miller*, *Zittel*, *Sherborn*, *Chapman*, *Rzehak*, *Bütschli*, *Wallich*, *Nicholson*, *Schlumberger*, *Quenstedt*, *de Folin*, *Millett*, *and others*.

General Characters.—Test free or adherent, rotaliform; plano-convex or trochoid, rarely complanate; aperture an arched slit, often protected by an umbilical flap,—the flaps sometimes forming a whorl of subsidiary chambers; shell coarsely porous.

1. Discorbina turbo (*d'Orbigny*), 1826. Plate VII, figs. 29 *a—c*.

Rotalia (Trochulina) turbo, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 274, No. 39; Modèle, No. 73.
— turbo, *J. and P.*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 306.
— — — 1860. Ann. Mag. N. H., ser. 3, vol. v, p. 293.
Discorbina turbo, *Carpenter*, *Parker*, *and Jones*, 1862. Introd. Foram., pp. 204 and 311.
— — vars., *P. and J.*, 1865. Phil. Trans., vol. clv, p. 384.
— — *P., J., and B.*, 1865. Ann. Mag. N. H., ser. 3, vol. xvi, p. 30, pl. ii, fig. 68.
— solarium, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, Memorie, vol. vi, p. 64, pl. vii, fig. 9.
— turbo, *Bütschli*, 1880. Bronn's Klassen, &c., p. 260, pl. ix, fig. 10.
— — *Terrigi*, 1883. Atti Accad. Pont. N. Lincei, vol. xxxv, p. 193, pl. iii, figs. 35, 36.
— — *Brady*, 1884. Report 'Challenger,' p. 642, pl. lxxxvii, figs. 8 *a—c*.
— — *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 421, fig. 266[21].
Rotalia (Trochulina) turbo, *Basset*, 1885. Ann. Soc. Sc. Char.-Inf. de 1884, p. 162 fig. 73.
Discorbina turbo, *Egger*, 1893. Abhandl. k. Akad. Bayer. Wiss., vol. xviii, pt. 2, p. 389, pl. xv, figs. 42—44.

Characters.—Shell trochoidal, upper face conical, lower face nearly flat; many chambers visible in the spire, five to nine shown below.

Occurrence.—This species, which is the type of the genus, is rather rare in the recent condition. The 'Challenger' obtained specimens off Cape de Verde Islands (11 fathoms), off Ascension (420 fathoms), near Pernambuco (350 fathoms), and at Port Jackson (2 to 10 fathoms). Brady also records specimens from the coral sands of Bermuda, and from Port Stephens, New South Wales. The 'Gazelle' obtained specimens from one station only, off Mauritius (223 fathoms).

The fossil records are from the Chalk of Maestricht; the Neocomian (Bargate Beds of Surrey); the Eocene (Calcaire Grossier); the Miocene of Calabria and of Muddy Creek (Victoria); and the Pliocene of St. Erth.[1] In the Coralline Crag we have specimens from Tattingstone and Broom Hill, zone **d**, from Sutton, zones **c** and **f**, and from Gedgrave, zone **f**.

2. Discorbina globularis (*d'Orbigny*), 1826. Plate VII, figs. 28 *a—c*.

Rosalina globularis, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 271, pl. xiii, figs. 1—4; Modèle, No. 69.
— varians, *Schultze*, 1854. Organ Polythal., p. 60, pl. iii, figs. 8—13.
Rotalina semiporata, *Egger*, 1857. Neues Jahrb., &c., p. 276, pl. viii, figs. 1—3.
— concamerata (young), *Williamson*, 1858. Rec. For. Gt. Br., p. 53, pl. iv, figs. 104, 105.
Discorbina turbo, var. globularis, *Carpenter, Parker, and Jones*, 1862. Introd. Foram., pp. 204 and 311, pl. iii, fig. 1.
— — var. vesicularis, sub-var. globularis, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 386, pl. xiv, figs. 20—23.
— globularis, *P.*, *J.*, *and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 30, pl, ii, fig. 69.
— — *Brady and Robertson*, 1870. Ibid., ser. 4, vol. vi, p. 306.
— — *Dawson*, 1874. Canad. Nat., ser. 2, vol. vii, p. 253, fig. *c*.
— — *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.
— — *Dawson*, 1876. Proc. Amer. Assoc. Detroit, p. 103, fig. 4 *c*.
— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 55.
Rosalina globularis, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 25, pl. ii (vii), figs. 10 *a—c*.
Discorbina globularis, *Terrigi*, 1880. Atti Accad. Pontan. N. Lincei, vol. xxxiii, p. 201, pl. iii, fig. 56.
— — *Möbius*, 1880. Meer. Mauritius, p. 96, pl. ix, fig. 18.

[1] The St. Erth specimens of *D. turbo* are similar to *D. solarium* of Seguenza. The specimen from the Crag here figured seems nearer to *D. rosacea*.—F. W. M.

Discorbina globularis, *Brady*, 1884. Report 'Challenger,' pp. 627 and 643, pl. lxxxvi, figs. 8, 13.
Rosalina globularis, *Basset*, 1885. Ann. Soc. Sci. Char.-Inf. de 1884, p. 169, fig. 69.
Discorbina globularis, *Brady*, 1887. Journ. R. Micr. Soc., p. 918.
— — *Walther*, 1888. Mitth. Zool. Stat. Neapol, vol. viii, p. 382, pl. xx, fig. 1.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 226, pl. xlvi, figs. 6 *a*—*c*.
— — *Terrigi*, 1889. Mem. R. Acc. Lincei, ser. 4, vol. vi, p. 115, pl. vi, fig. 20.
— — — 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 105, pl. iv, fig. 7.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, pl. xv, figs. 7—9.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 94, pl. xv, fig. 793.

Characters.—Helicoid shell, with low spire, showing several chambers, inflated, especially the last, sutures depressed, rarely limbate, lower face of shell nearly flat, showing about five chambers.

Occurrence.—*Discorbina globularis* has a wide geographical range, having been found in nearly all seas from Davis Strait in the North to Magellan's Strait in the South. It is more common in temperate and subtropical waters; and has not, according to the 'Challenger' Report, been yet found at depths greater than 450 fathoms.

Fossil specimens have been found in the Eocene, London Clay, and Calcaire Grossier, the Miocene of Bavaria, Southern Italy, and Muddy Creek (Victoria), the Pliocene of Italy and St. Erth, and in the Pleistocene of the British Isles, Italy, and elsewhere (Brady). It is not a common fossil in the Coralline Crag. The figured specimen is from Tattingstone, zone **d**.

3. Discorbina rosacea (*d'Orbigny*), 1826. Plate IV, figs. 17 *a*—*c*.

Part I, 1866, Appendices I and II, Tables, No. 76.

Ammoniæ *Planorbes, Soldani*, 1780. Sagg. Oritt., p. 104, pl. iii, fig. 24, m, M, N; and Test., vol. ii, Appendix, p. 140 (same figs.).
Rotalia rosacea, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 273, No. 15; Modèle, No. 39.
Asterigerina planorbis, *d'Orbigny*, 1846. For. Foss. Vien., p. 205, pl. xi, figs. 1—3.

Asterigerina rosacea, *d'Orbigny*, 1852. Prodrome Paléont., vol. iii, p. 158, No. 2952.
Rotalina mamilla, *Williamson*, 1858. Rec. For. Gt. Brit., p. 54, pl. iv, figs. 109—111.
Rotalia rosacea, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 129 (Table).
Discorbina rosacea, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473, No. 69.
Asterigerina planorbis, *Reuss*, 1864. Sitzungsb. Ak. Wiss. Wien, vol. l, p. 476.
Discorbina turbo, var. rosacea, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 385, pl. xvi, figs. 28 *a*, *b*.
— rosacea, *Parker, Jones, and Brady*, 1865. Ann. Nat. Hist., ser. 3, vol. xvi, p. 25, pl. ii, fig. 71.
— — *Brady*, 1865. Nat. Hist. Trans. Northumberland and Durham, vol. i, p. 104, No. 2.
Rotalina mamilla, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.
Discorbina planorbis, *Reuss*, 1866. Denkschr. k. Akad. Wiss. Wien, vol. xxv, p. 161.
— rosacea, *J., P., and B.*, 1866. Monogr. For. Crag, Appendices, No. 76, pl. iv, figs. 17 *a*—*c*.
— — *Sars*, 1868. Vidensk-Selsk. Forhandl. for 1868, p. 249.
— — *Brady*, 1868. (In Crosskey and Robertson) Trans. Geol. Soc. Glasgow, vol. iii, p. 125, &c.
Rotalina mamilla, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 13 (?).
Discorbina rosacea, *Brady*, 1870. Ann. Nat. Hist., 4th ser., vol. vi, p. 303.
— — *Parker, Jones, and Brady*, 1871. Ibid., vol. viii, p. 254.
— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., pt. 2, p. 55.
— — *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, No. 4, p. 105, pl. viii, figs. 251—257.
— — *Jones*, 1883. Microgr. Dict., ed. 4, p. 267, pl. xxiv, figs. 7 *a*, *b*.
— — *Brady*, 1884. Report 'Challenger,' p. 644, pl. lxxxvii, figs. 1 and 4.
Rotalia rosacea, *Basset*, 1885. Ann. Soc. Char.-Inf., vol. xxi, p. 162, fig. 39.
Discorbina rosacea, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 11 *a*, *b*.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 145.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 918.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 385, pl. xv, figs. 39—41.
— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 13.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 94, pl. xv, fig. 792.
— — *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 35, pl. iv, figs. 12 *a*—*c*.

Characters.—Shell trochoid, conical, composed of three to four convolutions, each consisting of from four to seven segments. Segments convex on their

anterior and peripheral borders, imparting thereby a lobulate outline to the margin of the shell. Anterior border of each segment overlapping the posterior portion of that immediately in front of it. Inferiorly the outlines of the segments less distinct, usually marked by irregular sinuate lines extending from the periphery to the umbilicus or near it. Aperture a long, narrow, arched fissure on the inferior umbilical border of the ultimate segment.

Occurrence.—*Discorbina rosacea* is exceedingly common, and according to the 'Challenger' Report, "within certain depths it is found in almost every sea, from the shores of Shetland and the Faröe Islands on the north to Magellan's Strait on the south. Its home is on shallow bottoms, and it becomes rare at greater depths than 250 fathoms; but occasional specimens are met with as low as 1000 fathoms." In contrast with this, Egger in his 'Gazelle' memoir records specimens from depths ranging from $1\frac{1}{2}$ to 2740 fathoms, and the larger number of his records are from depths exceeding 1000 fathoms. The figures given by Egger in his pl. xv, however, suggest a doubt in our minds as to the proper identification of the species.

The geological distribution of *D. rosacea* extends to the Neocomian (Bargate Beds). Specimens have also been recorded from the Eocene (London Clay and Calcaire Grossier), the Miocene of Vienna, Muddy Creek (Victoria), and Italy, the Pliocene of Italy and St. Erth, and the Pleistocene of the British Islands and the islands of Ischia. In the Coralline Crag we have specimens from nearly every zone examined; and, as recorded in the First Part of this Monograph, the shell has also been found in the Upper Crag of Southwold.

4. Discorbina orbicularis (*d'Orbigny*), 1826. Plate VII, figs. 31 *a*—*c*.

Discorbis orbicularis, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 274, No. 35.
Rosalina orbicularis, *d'Orb.*, 1847–50. Prodrome, part 2, p. 407, No. 1328.
— — (?), *Terquem*, 1876. Plage Dunkerque, p. 75, pl. ix, figs. 4 *a*, *b*.
Asterigerina Rhodiensis, *Terquem*, 1878. Mém. Soc. Géol. France, ser. 3, vol. i, p. 31, pl. iii (viii), figs. 1—4.
Discorbis orbicularis, *Berthelin*, 1878. Ann. Soc. Ac. Nantes, ser. 5, vol. viii, p. 242, No. 63.
Discorbina rosacea, *Terrigi*, 1880. Atti Accad. Pontif. N. Lincei, vol. xxxiii, p. 200, pl. iii, figs. 54, 55.
— minutissima, *Seguenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 149, pl. xiv, figs. 1, 1 *a*, 1 *b*.
— orbicularis, *Brady*, 1884. Report 'Challenger,' p. 647, pl. lxxxviii, figs. 4—8.
— — *Balkwill and Millett*, 1884. Journ. Micr., vol. iii, p. 23, pl. iv, fig. 13.

Discorbina orbicularis, *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci.), p. 349, pl. xiii, figs. 31—33.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 918.
— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 227, pl. xlvi, fig. 1.
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 115, pl. vii, figs. 2, 3.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, pt. 2, p. 389, pl. xv, figs. 16—18, 76—78.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 69.

Characters.—Test thin, depressed, slightly conical above, flat or nearly so below. The upper face shows numerous long, narrow, curved and overlapping chambers; the last the longest. Sutures usually simple, sometimes slightly limbate. On the lower face only three or four chambers visible, the last much the largest. Umbilical flaps present.

Occurrence.—*Discorbina orbicularis* has a very wide geographical and bathymetrical range, but it has not hitherto been found in Arctic or Antarctic waters. The Irish Sea appears to be the most northern limit known. The 'Challenger' Report states that it is plentiful in the shallow water among the Pacific Islands, and also amongst the West Indies. Egger, in his 'Gazelle' Memoir, records it from the Cape Verde Islands and other points off the West Coast of Africa, Mauritius, Western Australia, and the Atlantic Ocean. The greatest depth recorded in the 'Challenger' Report is 435 fathoms; but the 'Gazelle' obtained specimens from a depth of 2590 fathoms in the South Atlantic Ocean.

As a fossil it has been recorded from the Neocomian (Bargate Beds of Surrey), the Miocene of Italy and Muddy Creek (Victoria), and the Pliocene of Italy and St. Erth. In the Coralline Crag we have found it in every zone examined.

5. Discorbina parisiensis (*d'Orbigny*), 1826. Plate II, figs. 13—15.

Part I, 1866; Appendices I and II, Tables, No. 77.

Rosalina parisiensis, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 271, No. 5; Modèle, No. 38.
Discorbina parisiensis, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 25, pl. ii, fig. 70.
— — *J., P., and B.*, 1866. Monogr. For. Crag, App. i and ii, Tables, No. 77, pl. ii, figs. 13—15.

DISCORBINA PARISIENSIS, *Morris*, 1876.	Lect. Geol. Croydon, p. 8, figs. 3 and 7.
— — *Wright*, 1877.	Proc. Belfast Field Club for 1876–7, Appendix, p. 105, pl. iv, figs. 1 *a—d* (not 2 *a—c*).
DISCORBIS PARISIENSIS, *Berthelin*, 1878.	Ann. Soc. Ac. Nantes, ser. 5, vol. viii, p. 242, No. 65.
ROSALINA PARISIENSIS, *Terquem*, 1882.	Mém. Soc. Géol. France, ser. 3, vol. ii, p. 99, pl. x (xviii), figs. 15—17.
DISCORBINA PARISIENSIS, *Brady*, 1884.	Rep. 'Challenger,' pp. 627 and 648, pl. xc, figs. 5, 6, 9—12.
— — — 1887.	Journ. R. Micr. Soc., p. 919.
— — *Egger*, 1893.	Abhandl. k. Ak. Bayer. Wiss., vol. xviii, part 2, p. 391, pl. xv, figs. 25—30.
— — *Goës*, 1894.	K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 93, pl. xv, fig. 791.

Characters.—Shell plano-convex, sometimes with an obtusely pointed apex; consisting of two or three convolutions of long, oblique, arcuate chambers, seven to nine in a convolution; inferiorly the segments of the last convolution extend to the umbilicus. Upper surface smooth; the last and the earlier chambers variously exposed in different specimens; the sutures simple; the lower face of the shell shows several curved and some intercalated chambers, and is ornamented with radiating lines of minute tubercles. Peripheral margin thin, rarely lobulate.

Occurrence.—*Discorbina parisiensis* is generally of rare occurrence in the recent condition, and appears to have a somewhat restricted range; but it is not uncommon in the shore-sand of Mount's Bay, Cornwall (Millett). The 'Challenger' found specimens only off Kerguelen at depths of 20 to 50 fathoms. The 'Gazelle' found specimens off Kerguelen, and also off Mauritius (70 to 220 fathoms); off South-West Australia (2159 fathoms), and off West Australia at less depths. Specimens have also been obtained in shallow water off the coasts of Ireland and France.

The earliest records of the species in a fossil condition is from the Neocomian (Bargate Beds) of Surrey. It has also been found in the Eocene (Calcaire Grossier), and in the Pliocene of St. Erth. We have specimens in our own collections from the Casterlian and Scaldisian of the Kattendyk Docks, Antwerp. In the Coralline Crag we have found it in every zone examined, and it has also been obtained (small and rare), as stated in the First Part of this Monograph, from the Red Crag.

6. DISCORBINA LINGULATA, sp. nov., *Burrows and Holland.* Plate VII, figs. 33 *a—c*.

DISCORBINA BICONCAVA, *Brady*, 1884.	Report "Challenger,' p. 653, pl. xci, fig. 3 (not fig. 2).

Characters.—Test compressed, flat or concavo-convex; periphery somewhat square; sutures more or less limbate on the aboral (" superior ") face, and having interlocking angles on the oral face. The aboral surface of several of the chambers ornamented with a slightly raised boss.

We think Brady mistaken in admitting fig. 3 on pl. xci of the 'Challenger' Report as *D. biconcava*, P. and J. It has limbate sutures upon one side only, is not biconcave, and has not a square limbate periphery. The aboral face (fig. 3 *a*) is strikingly like our fig. 33 *a*, Pl. VII, and also like our specimens from the Miocene of Muddy Creek (Victoria).

Occurrence.—The figured specimen is from the Coralline Crag of Sutton, zone **f**; and, as mentioned above, we have specimens from the Miocene of Australia exactly corresponding with the specimen from the Crag.

Genus 2.—Planorbulina, *d'Orbigny*, 1826.

Carpenter, Parker, and Jones, Introd. Foram., 1862, *p.* 206; *Brady, Report 'Challenger,'* 1884, *pp.* 627, 655, 656.

Planorbulina, emended by *Carpenter, Parker, and Jones*, comprised *Planorbulina, Truncatulina, Anomalina, Siphonina*, and *Planulina* of authors.
Planorbulina, *d'Orbigny, Bronn, von Münster, Römer, von Hagenow, von Reuss, Costa, Williamson, Parker and Jones, Carpenter, Karrer, Brady, M. Sars, Fischer, Schulze, Terquem, von Zittel, Schwager, Bütschli, Terrigi, Quenstedt, Basset, Carter, Fornasini, Millett, Egger, Goës, Balkwill and Wright, and others.*

General Characters.—Test usually adherent; flattened; chambers numerous, at first spiral, then cyclical, sometimes irregular and acervuline; apertures opening on the periphery and lipped. Shell-wall coarsely perforate.

1. Planorbulina Mediterranensis (*d'Orbigny*), 1826. Plate II, fig. 3; Plate V, fig. 30.

Part I, 1866, Appendices I and II, Tables, No. 78.

Corpuscula *plano-papillosa, Soldani*, 1795. Testaceographia, vol. i, pt. iii, p. 238, pl. 161, figs. *E, F, G*; pl. 162, fig. *H*.
Planorbulina Mediterranensis, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 280, No. 2, pl. xiv, figs. 4—6 *bis*; Modèle, No. 79.
-- difformis, *Römer*, 1838. Neues Jahrb. für Min., p. 390, pl. iii, fig. 59.

PLANORBULINA VULGARIS, *d'Orb.*, 1839. Foram. Cuba, p. 85, pl. vi, figs. 11—15.
— — — 1839. Foram. Canaries, p. 134, pl. ii, fig. 30.
— — *Reuss*, 1845-6. Geinitz's Grundriss, &c., p. 675, pl. xxiv, fig. 44.
— MEDITERRANENSIS, *d'Orb.*, 1846. For. Foss. Vien., p. 166, pl. ix, figs. 15—17.
— — *Williamson*, 1847 and 1872. Mem. Lit. Phil. Soc. Manchester, vol. viii, pp. 36, 43, pl. ii, figs. 27—29 ("*Rosalina globularis*"); and ibid., ser. 3, vol. v, pp. 133, 134.
— — *Costa*, 1856. Atti Acc. Pontan., vol. vii, pt. 2, p. 244, pl. xx, fig. 7.
— VULGARIS, *Williamson*, 1858. Rec. For. Gt. Brit., p. 57, pl. v, figs. 119, 120.
— MEDITERRANENSIS, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, Table, No. 98.
— VULGARIS, *Carpenter*, 1862. Introd. Foram., p. 208, pl. xiii, figs. 13—15.
— MEDITERRANENSIS, *Parker and Jones*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 440, No. 17.
— — *Karrer*, 1864. Sitzungsb. k. Akad. Wiss. Wien, vol. l, p. 721.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473, No. 73.
— — *Parker, Jones, and Brady*, 1865. Ann. Nat. Hist., ser. 3, vol. xvi, p. 31, pl. ii, fig. 74.
— FARCTA, var. MEDITERRANENSIS, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 383, pl. xvi, fig. 21.
— MEDITERRANENSIS, *Brady*, 1865. Nat. Hist. Trans. Northd. and Durham, vol. i, p. 104, No. 1.
— MEDITERRANEA, *Reuss*, 1865. Model, No. 79 (Catal., 1861, No. 90).
— MEDITERRANENSIS, *J., P., and B.*, 1866. Monogr. For. Crag, Append. I and II, No. 78, pl. ii, fig. 3.
— — *Brady*, 1868. Proceed. Phil. Soc. Glasgow, vi, p. 357; Trans. Geol. Soc. Glasgow, vol. iii, p. 127.
— — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
— MEDITERRANEA, *Reuss*, 1869. Sitzungs. Ak. k. Wiss. Wien, vol. lix, p. 460.
— MEDITERRANENSIS, *Brady and Robertson*, 1870. Ann. Nat. Hist., ser. 4, vol. vi, pp. 303, 306.
— — *Parker, Jones, and Brady*, 1871. Ibid., vol. viii, p. 178, pl. xii, fig. 133.

PLANORBULINA MEDITERRANENSIS, *Jones and Parker*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 119.
— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
— VULGARIS, *Terquem*, 1875. Plage Dunkerque, p. 30, pl. iv, fig. 1.
— DISTOMA, *Terquem*, 1876. Ibid., p. 73, pl. viii, fig. 11.
— INFLATA, *Terquem*, 1876. Ibid., p. 74, pl. viii, fig. 12.
— RADIATA, *Terquem*, 1876. Ibid., p. 74, pl. viii, fig. 13.
— MEDITERRANENSIS, *Zittel*, 1876. Handb. Pal., part 1, p. 93, fig. 30^2.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., p. 26, fig. 55.
— VULGARIS, *Carter*, 1877. Ann. Mag. Nat. Hist., ser. 4, vol. xix, p. 218, pl. xiii, fig. 17.
— MEDITERRANENSIS, *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 55.
— — *Bütschli*, 1880. Bronn's Klassen, &c., p. 206, pl. ix, fig. 8.
— FARCTA, var. VULGARIS, *Goës*, 1882. K. Sv. V.-Ak. Handl., vol. xix, No. 4, p. 97, pl. vii, figs. 226 (?), 227.
— NODOSA, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 91, pl. xvii, fig. 16.
— VICINALIS, *Terquem*, 1882. Ibid., p. 90, pl. xvii, fig. 14.
— MEDITERRANENSIS, *Jones*, 1883. Microgr. Dict., ed. 4, p. 605, pl. xxiv, fig. 10.
— — *Terrigi*, 1883. Atti Acc. Pont. Lincei, vol. xxxv, p. 194, pl. iii, fig. 38.
— — *Brady*, 1884. Report 'Challenger,' p. 656, pl. xcii, figs. 1—3.
— — *Basset*, 1885. Ann. Soc. Sci. Char.-Inf. de 1884, p. 162, fig. 79.
— — *Quenstedt*, 1885. Handb. Petref., ed. 3, pt. 5, p. 1058, pl. lxxxvi, fig. 50.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 224, 225.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 920.
— — *B., P., and J.*, 1888. Tr. Zool. Soc., vol. xii, part vii, p. 227, pl. xlv, figs. 18 *a*, *b*.
— — (MEDITERRANEA in Expl. of plate), *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, pt. 2, p. 380, pl. xiv, figs. 24—26 (young form).
— — *Goës*, 1894. K. Sv. V.-Akad. Handl., vol. xxv, No. 9, p. 91, pl. xv, fig. 786.

Planorbulina Mediterranensis, *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 32, pl. v, figs. 12, 13.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 73.

Characters.—Shell free at first, parasitic afterwards, thin, outspread, one face ("superior" and attached), somewhat flatter than the other; the periphery almost circular, subangular, or irregular. Chambers numerous, inflated, arranged subcyclically on one plane; early spiral chambers visible in the middle of the attached face; septal orifices somewhat obscure, but usually at both ends of the outer chambers on the periphery.

Pl. II, fig. 3, represents a feeble individual of the Northern form *vulgaris*.

Occurrence.—According to the 'Challenger' Report, this species occurs "in almost every sea within the temperate and tropical zones." It is commonest at depths of less than 50 fathoms, but one specimen has been found at a depth of 1125 fathoms. Egger in his 'Gazelle' Memoir records the occurrence of rare specimens at one station off Kerguelen Island.

Fossil specimens have been obtained from the Oligocene of Elsass, the Miocene of Vienna and Muddy Creek (Victoria), the Pliocene of Italy, Antwerp (Casterlian), and St. Erth, and in the Pleistocene of many localities. In the Coralline Crag we have examples from every zone examined.

Genus 4.—Truncatulina, *d'Orbigny*, 1826.

Brady, Report '*Challenger*,' 1884, *pp.* 73, 655, *and* 658.

Nautilus, *Walker and Boys, Fichtel and Moll, Maton and Rackett, Turton, Pennant, Dillwyn.*

Serpula, *Montagu.*

Rotalia, *Lamarck, d'Orbigny, Römer, von Reuss, Karrer, Stache, von Gümbel.*

Polyxenes, *de Montfort.*

Cibicides, *de Montfort, Blainville.*

Cristellaria, *Lamarck.*

Truncatulina, *d'Orbigny, Bronn, von Münster, Römer, von Reuss, Costa, Egger, Parker and Jones, Williamson, Karrer, Seguenza, Brady, G. M. and J. W. Dawson, M. Sars, von Hantken, Winther, Wright, Terquem, Toutkowski, Andreae, Ehrenberg, Terrigi, Malagoli, Schwager, Uhlig, Karrer, von Gümbel, Gosse, Mantell, Pictet, Carpenter, Marsson, Hopkins, Nicholson, Sherborn Chapman,*

Rzehak, von Hagenow, Mackie, Schultze, Wright, Wood, von Schlicht, Millett, A. Silvestri, Grzybowski, and others.

LOBATULA, *Fleming, Thorpe.*

ROSALINA, *d'Orbigny, Alth, von Reuss, Stache, von Gümbel.*

ROTALINA, *d'Orbigny, Czjzek, von Reuss, Bailey, Bornemann, Egger, Karrer, Seguenza, Martonfi.*

DISCORBIS, *Macgillivray.*

ANOMALINA, *d'Orbigny, Schwager.*

SIPHONINA, *von Reuss, Costa, Karrer, Terrigi, Seguenza.*

PLANORBULINA, *Parker and Jones, Carpenter, Brady, Siddall.*

General Characters.—Free or adherent, rotaliform; generally more convex on the oral surface. Shell-wall coarsely porous; surface often tuberculate; aperture a curved slit at the inner edge of the last segment, sometimes with an elongate neck and lip.

1. TRUNCATULINA REFULGENS (*Montfort*), 1808. Plate V, figs. 31 *a*, 31 *b*.

Part I, 1866, Appendices I and II, Tables, No. 82.

Hammonia *Balanus* seu *Balanoidea, Soldani,* 1789. Testaceographia, vol. i, pt. 1, p. 58, pl. xlvi, figs. *nn, oó.*

CIBICIDES REFULGENS, *Montfort,* 1808. Conchyl. Syst., vol. i, p. 122, 31re genre.

— — *Defrance,* 1824 (*fide* Blainville). Dict. Sci. Nat., vol. ix, p. 188; vol. xix, p. 2; vol. xxxii, p. 187; Atlas Conch., pl. xix, fig. 2.

— — *Blainville,* 1825. Manuel Malacol., p. 391, pl. x, fig. 2.

TRUNCATULINA REFULGENS, *d'Orbigny,* 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 5, pl. xiii, figs. 8—11; Modèle, No. 77.

PLANORBULINA (TRUNCATULINA) REFULGENS, *Jones and Parker,* 1860. Q. J. Geol. Soc., vol. xvi, p. 302, No. 100 (Table).

TRUNCATULINA REFULGENS, *Parker and Jones,* 1860. Ann. Mag. Nat. Hist., 3 ser., vol. vi, p. 340, No. 17.

— — — 1863. Ibid., vol. xii, p. 202, No. 3, p. 437, No. 62.

— — *Carpenter,* 1862. Introd. Foram., p. 201, fig. xxxii, E.

— — *Brady,* 1865. Nat. Hist. Trans. Northld. and Durham, vol. i, p. 105, pl. xii, fig. 9.

— — *Parker, Jones, and Brady,* 1865. Ann. Mag. Nat. Hist., 3 ser., vol. xvi, p. 31, pl. ii, fig. 76.

— LOBATULA (passing into REFULGENS), *Parker and Jones,* 1865. Phil. Trans., vol. clv, p. 382, pi. xvi, figs. 18—20.

TRUNCATULINA REFULGENS, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, App. I and II, No. 82.
— — *Sars*, 1868. Vidensk-Selsk. Forhandl. for 1868, p. 248.
— — *Brady*, 1868. Proc. Geol. Soc. Glasgow, vol. vi, p. 362
— — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 303.
— — *P., J., and B.*, 1871. Ibid., ser. 4, vol. viii, p. 176, pl. xii, fig. 139.
— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
— — *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 197, pl. iii, fig. 40.
— — *Brady*, 1884. Report 'Challenger,' p. 659, pl. xcii, figs. 7—9.
— — *Basset*, 1885. Ann. Soc. Sci. N. Char.-Inf., No. 21, p. 162, fig. 77.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 167, 168.
— — *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 13 *a—c*.
— — *Brady*, 1887. Ibid., vol. vii, p. 920.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, p. 401, pl. xvi, figs. 31—33.
PLANORBULINA REFULGENS, *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 89, pl. xv, figs. 775, 776.

Characters.—Shell free or parasitic, regular; conical or plano-convex. Oral surface conical or dome-shaped, aboral surface flat or slightly concave; chambers long, arcuate, somewhat inflated. Foramina inconspicuous.

This is but an exaggerated condition of *Tr. lobatula* in which the convexity of the oral surface is increased, sometimes so much as to give the shell the form of a tall cone. The pseudopodial perforations are commonly obliterated by the free deposit of shell-substance. In other respects the characters of *Tr. lobatula* apply equally to *Tr. refulgens*.

Occurrence.—*Truncatulina refulgens,* according to the 'Challenger' Report, is confined to temperate seas, and occurs at depths of from 45 to 2400 fathoms. Egger in his 'Gazelle' Memoir records specimens from off Mauritius and North Australia at depths of 74 and 194 fathoms respectively.

Fossil specimens have been obtained from the London Clay, the Pliocene of Southern Italy, and from the Pleistocene of Ireland. In the Coralline Crag we have specimens from Tattingstone, Sudbourne, and Broom Hill (zone **d**), and from Aldborough (zone **g**). It has also been recorded in the First Part of the Monograph from the Red Crag.

2. Truncatulina lobatula (*Walker*), 1784. Plate II, figs. 4—10; Plate IV, fig. 19.

Part I, 1866, Appendices I and II, Tables, No. 81.

Ammoniæ *Plano-convexæ, Soldani*, 1780. Saggio Oritt., p. 104, pl. iii, figs. 26, Q, R.
Nautilus lobatulus, *Walker*, 1784. Test. Min., p. 20, pl. iii, fig. 71.
Hammoniæ tuberculatæ, pseudoparasiticæ, &c., *Soldani*, 1789. Testaceographia, vol. i, pt. 1, p. 58, pl. xlv, figs. *gg, hh, ii, kk, ll, mm.*
[We may note that, besides these figures of the more common aspect of *Tr. lobatula*, nearly all the figures in pls. xli, xlii, xliii, xliv, and xlv, described by Soldani at pp. 57, 58, represent various modifications of the same sub-type.]
Ammoniæ *Plano-convexæ, Soldani*, 1798. Ibid., vol. ii, App., p. 140, pl. iii, fig. 26 *q, Q, R.*
Nautilus lobatulus, *Walker and Jacob*, 1798 (*fide* Kanmacher). Adams's Essays, 2nd edit., p. 642, pl. xiv, fig. 36.
— — *Turton*, 1800–6. Linn. Syst. Nat., vol. iv, p. 307.
Serpula lobatula, *Montagu*, 1803, 1809. Test. Brit., p. 515; 1809, Supplement, p. 160.
Nautilus lobatulus, *Pennant*, 1812. Brit. Zool., vol. iv, p. 248.
— — *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 117.
— — *Dillwyn*, 1817. Descr. Cat., vol. i, p. 343.
— — *Turton*, 1819. Conch. Dict., p. 120.
— — *Wood*, 1825. Index Testac., p. 64, pl. xiii, fig. 13.
Truncatulina tuberculata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 1; Modèle, No. 37.
Planulina incerta (? young), *d'Orbigny*, 1826. Ibid., p. 280, No. 3.
Truncatulina tuberculata, *Risso*, 1826. Hist. Nat. Europ. Mérid., vol. iv, p. 19, No. 46.
Lobatula vulgaris, *Fleming*, 1828. Brit. Anim., p. 232.
Truncatulina communis, *Römer*, 1838. Neues Jahrb., &c., Jahrg. 1838, p. 389, pl. iii, fig. 56.
[Not described], *Costa*, 1838. Fauna Regno Napoli, pl. iii, fig. 8.
Truncatulina advena, *d'Orb.*, 1839. Foram. Cuba, p. 87, pl. vi, figs. 3—5.
— dispars, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 38, pl. v, figs. 25—27.
— depressa, *d'Orb.*, 1839. Ibid., p. 39, pl. vi, figs. 4—6 (thin).
— lobata, *d'Orb.*, 1839. Foram. Canaries, p. 134, pl. ii, figs. 22—24.
— lævigata, *Römer*, 1841. Verstein. Norddentsch. Kreid., p. 97, pl. xv, fig. 23.
Discorbis lobatulus, *Macgillivray*, 1843. Moll. Anim. Aberd., p. 34.
Lobatula vulgaris, *Thorpe*, 1844. Brit. Mar. Conch., p. 235.
Truncatulina communis, *Philippi*, 1844. Beit. Kennt. Tertiärverstein., p. 42, No. 31.

TRUNCATULINA LÆVIGATA, *Reuss*, 1845. Verstein. Böhm. Kreid., p. 37, pl. viii, fig. 71; and pl. xiii, fig. 47.

— LOBATULA, *d'Orb.*, 1846. For. Foss. Vien., p. 168, pl. ix, figs. 18—23.

— BOUEANA, *d'Orb.*, 1846. Ibid., p. 169, pl. ix, figs. 24—26.

ANOMALINA VARIOLATA (VARIOLARIA on the plate), *d'Orb.* Ibid., p. 170, pl. ix, figs. 27—29.

TRUNCATULINA LOBATULA, *Williamson*, 1847 and 1872. Mem. Lit. Phil. Soc. Manch., vol. viii, p. 46, pl. iii, fig. 35 ("*tuberculata*"); ibid., ser. 3, vol. v, p. 134.

ROSALINA GALICIANA, *Alth*, 1850. Haidingers Naturwiss. Abhand., vol. iii, p. 265, pl. xiii, fig. 20.

TRUNCATULINA BOUEANA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesellsch., vol. iii, p. 158, No. 40.

— LOBATULA, *Reuss*, 1851. Ibid., No. 41.

— — *Bronn*, 1853-56. Leth. Geogn., edit. 3, part 3, p. 224, pl. $xxxv^2$, figs. 16 *a*, *b*, *c*.

— — *Gosse*, 1855. Man. Mar. Zool., p. 12, fig. 20.

ROTALIA DEPLANATA, *Reuss*, 1855. Zeitschr. Deutsch. Geol. Gesellsch., vol. vii, p. 288, pl. xi, fig. 3.

TRUNCATULINA CONCINNA, *Reuss*, 1855. Ibid., fig. 4.

— LOBATULA, *Reuss*, 1855. Sitzungsbr. k. Ak. Wiss. Wien, vol. xviii, pp. 203, 208, &c.

— COMMUNIS, *Reuss*, 1855. Ibid., p. 242, pl. v, fig. 56.

— LOBATULA, *Costa*, 1856. Atti Acc. Pont., vol. vii, part 2, p. 249, pl. xiv, figs. 7 A, B; pl. xx, fig. 12 (*alternans* at p. 250).

— [indet.], *Mantell*, 1857. Wonders Geol., ed. 7, p. 253, lign. 45.

— LOBATULA, *Pictet*, 1857. Traité Pal., ed. 2, vol. iv, p. 510, pl. cix, fig. 30.

— — *Egger*, 1857. Neues Jahrb., &c., Jahrg. 1857, p. 279, pl. ix, figs. 1—3.

— — *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., 2 ser., vol. xix, p. 293, pl. x, figs. 17—21.

— — *Williamson*, 1858. Rec. For. Gt. Br., p. 59, pl. v, figs. 121—123.

— — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., 3 ser., vol. iv, pp. 339 and 348.

— — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 99 (Table).

— VARIANS, *Reuss*, 1860. Sitz. k. Ak. Wiss. Wien, vol. xlii, p. 359, pl. ii, figs. 12 *a*, *b*, *c*.

— DEKAYI, *Reuss*, 1861. Ibid., vol. xliv, p. 338, pl. vii, fig. 6.

ROSALINA BOSQUETI, *Reuss*, 1861. Ibid., p. 316, pl. iii, fig. 1.

TRUNCATULINA LOBATULA, *Karrer*, 1861. Ibid., p. 455, No. 129, Table.

— — *Carpenter*, 1862. Introd. Foram., p. 201, fig. xxxii B, pl. iv, fig. 5.

TRUNCATULINA LOBATULA, *Karrer*, 1863. Sitz. Ak. Wiss. Wien, vol. xlviii, p. 101.
— — — 1864. Ibid., vol. l, pp. 694 and 720.
— — *Reuss*, 1864. Ibid., p. 477.
— COMMUNIS, *Reuss*, 1864. Ibid., p. 477.
PLANORBULINA (TRUNCATULINA) LOBATULA, *Jones and Parker*, 1864. Geologist, vol. vii, p. 87.
TRUNCATULINA LOBATULA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 76.
— — — 1865. Nat. Hist. Trans. Northld. and Durham, vol. i, p. 105, No. 1.
PLANORBULINA FARCTA, var. (TRUNCATULINA) LOBATULA, *Parker and Jones*, 1865, Phil. Trans., vol. clv, p. 381, pl. xiv, figs. 3—6; pl. xvi, figs. 18—20.
TRUNCATULINA LOBATULA, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., 3 ser., vol. xvi, p. 25, pl. ii, fig. 77.
— — *Sars*, 1865. Foss. Dyrelevn. Qvartærperioden, p. 10, &c.
— — *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices, pl. ii, figs. 4—10; pl. iv, fig. 19.
— COMMUNIS, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 159.
— BOUEANA, *Reuss*, 1866. Ibid., p. 159.
— LOBATULA, *Reuss*, 1867. Sitzungsb. k. Ak. Wiss. Wien, vol. lv, p. 99.
— — *Karrer*, 1868. Ibid., vol. lviii, p. 181, No. 6.
— — *Karrer and Fuchs*, 1868. Jahrb. Geol. Reichsanst., Jahrg. 1868, p. 579, &c.
— — *Fuchs and Karrer*, 1868. Ibid., p. 270.
— — *Brady*, 1868. (In Crosskey and Robertson) Proc. Phil. Soc. Glasgow, vol. vi, p. 351, &c.
— — *Sars*, 1869. Forhandl. Vidensk.-Selsk. for 1868, p. 248.
— — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
— — *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, p. 416, fig. 35.
— — *G. M. Dawson*, 1870. Ibid., vol. v, p. 179.
— — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, pp. 303, 306.
DISCORBINA DANUBIA, *Karrer*, 1870. Jahrb. k.-k. Geol. Reichsanst., Jahrg. 1870, p. 184, pl. ii, fig. 15.
TRUNCATULINA LOBATULA, *Parker, Jones, and Brady*, 1871. Ibid., vol. viii, pp. 176, 177, Nos. 86, 90, pl. xii, figs. 136, 137.
— — *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanst., vol. xxi, pp. 70, 71, &c.
— — *Jones and Parker*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 119.
— — *J. W. Dawson*, 1872. Canad. Nat., n. s., vol. vi, p. 255, pl. iii, fig. 3.

TRUNCATULINA LOBATULA, *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.
— — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 30, pl. iv, figs. 2 *a—c*.
— — *Vanden Broeck*, 1876. Mém. Soc. Belg. Microsc., vol. ii, p. 138.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 49.
— — *Marsson*, 1878. Mitth. nat. Ver. Neu-Vorpom., vol. x, p. 167, pl. v, figs. 38 *a—g*.
— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 55.
— — *Vine*, 1878. Science Gossip, p. 52, figs. 39, 40.
— [indet.], *Hopkins*, 1878–9. Congr. Sess. 3, vol. iv, Rep., pt. 2, App. iv, p. 885, pl. i, fig. 65.
— LOBATULA, *Nicholson*, 1879. Man. Palæont., vol. i, p. 117, fig. 18 *p*.
— — *Terrigi*, 1880. Atti Acc. Pont. Linc., vol. xxxiii, p. 205, pl. iii, fig. 57.
— — *Terquem*, 1881. Plage Dunkerque (3), p. 126, pl. xvi, figs. 4 *a—c*.
— — var. UMBILICATA, *Terquem*, 1881. Ibid., figs. 5 *a—c*.
— — *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, No. 3, p. 94, pl. ix (xvii), figs. 27 *a*, *b*.
PLANORBULINA FARCTA, *Goës* (?), 1882. K. Svensk. Vet.-Ak. Handl., vol. xix, No. 4, p. 96, pl. vii, figs. 220—225.
TRUNCATULINA LOBATULA, *Jones*, 1883. Microgr. Dict., ed. 4, p. 784, pl. xxiv, figs. 9 *a*, *b*.
— — *Brady*, 1884. Report 'Challenger,' pp. 627, 660, pl. xcii, fig. 10; pl. xciii, figs. 1, 4, 5; pl. cxv, figs. 4, 5.
— TUBERCULATA, *Bassett*, 1884. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 162, fig. 37.
— LOBULATA, *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 421, fig. 266 .
— — *Sir J. W. Dawson*, 1886. Handb. Zool., ed. 3, p. 46, fig. 39.
— LOBATULA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 145, 165—167.
— — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 12 *a—c*.
— — *Malagoli*, 1887. Atti Soc. Nat. Modena: Rendiconti, ser. 3, vol. iii, p. 110, pl. i, fig. 14.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 920.
— — *Toutkowski*, 1888. Zap. Kievskago, &c., vol. ix, p. 46, pl. vii, figs. 1 *a—c*.

Truncatulina lobatula, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 227, pl. xlii, fig. 20; pl. xlv, figs. 26 *a—c*.
— — *Steinmann*, 1888. Elemente Paläont., vol. i, p. 29, figs. 11 A, B, C.
Rosalina, sp., *Beissel*, 1891. Abhandl. k. Preuss. Geol. Landes., part 3, p. 74, pl. xiv, figs. 30—35.
Truncatulina lobatula, *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 396, pl. xvi, figs. 1—3, 10—12.
— — *Fornasini*, 1893. Istit. Bologna, ser. 5, vol. iii, p. 435, pl. o, figs. 15, 15 *a*, 16, 16 *a*.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 414.
Planorbulina lobatula, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 88, pl. xv, fig. 774.
Truncatulina lobatula, *De Amicis*, 1895. Nat. Sicil. Ann., xiv, pp. 52 and 63.
— — *Egger*, 1895. Jahresb., xvi, Nat. Ver. Passau, p. 31, pl. v, figs. 5 *a—c*.
Planorbulina lobatula, *Goës*, 1896. Bull. Mus. C. Z, Harvard Coll., vol. xxix, p. 70.

Characters.—Shell suborbicular, plano-convex, consisting of from two to three convolutions, of which the outermost alone is visible on the convex surface. Each convolution composed of seven or eight segments. Convex surface depressed at the umbilicus. Segments ventricose on the upper, flat and truncate on the lower surface of the shell. Orifice single, large, at inner margin of the terminal chamber. Foramina conspicuous chiefly in young specimens.

Occurrence.—*Truncatulina lobatula* is found in all seas and at all depths down to 3000 fathoms. It is the most common of the Rotaline Foraminifera. Its geological range is also very great. Specimens have been obtained from rocks of Carboniferous age; and it is commonly met with in Mesozoic and later deposits. As a Tertiary fossil its range is similarly wide, and the amount of attention that has been bestowed upon it by naturalists may be seen from the table of synonyms given above.

In the Coralline Crag it is common in every zone we have examined; and it has also been found in the Upper Crag, as recorded in the First Part of the Monograph.

3. Truncatulina variabilis, *d'Orbigny*, 1826. Plate VI, fig. 23.

Testæ hammoniformes, *plano-cochleatæ, tuberosæ, articulatæ*, &c., *Soldani*, 1789. Testaceographia, vol. i, pt. 1, pp. 77—80, pls. lxix and lxx (partly), lxxi—xcii, and xciii (partly).

Truncatulina variabilis, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 8.

— — — 1839. Foram. Canaries, part 2, p. 135, pl. ii, fig. 29.

— innormalis, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 368, pl. xxi, figs. 11 A, B, C.

— excedens, *Costa*, 1856. Ibid., vol. vii, p. 250.

Planorbulina truncata, *Egger*, 1857. Neues Jahrb., &c., p. 280, pl. x, figs. 15—17.

Truncatulina variabilis, *Reuss*, 1864. Denksch. k. Akad. Wiss. Wien, vol. xxiii, p. 10, pl. i, fig. 15.

— — *Mackie*, 1867. Sci. Gossip, p. 131, fig. 139.

Planorbulina variabilis, *Reuss*, 1869. Sitz. k. Akad. Wiss. Wien, vol. lix, p. 460.

Truncatulina variabilis, *Reuss*, 1870. Ibid., vol. lxii, p. 490, No. 1.

Nonionina, Anomalina, Truncatulina, Rotalina, *Schlicht*, 1870. Pietzpuhl, pp. 59, 60, 63, 64, pl. xxi, figs. 12—23, 27—29; pl. xxii, figs. 7—9, 20—23.

Truncatulina tuberosa, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 177, pl. xii, fig. 138.

Planorbulina (Truncatulina) variabilis, *P. and J.*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 104.

Truncatulina variabilis, *Terquem*, 1876. Plage Dunkerque, fasc. 2, p. 75, pl. ix, figs. 3 *a*, *b*.

— tuberosa, *Brady*, 1877. Ann. Mag. N. H., ser. 4, vol. xix, p. 107.

— variabilis, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 20, pl. i (vi), figs. 18—25.

— — var. obscura, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 127, pl. xvi, figs. 7 *a*, *b*.

— — *Terquem*, 1882. Mém. Soc. Géol. Fr., sér. 3, vol. ii, pt. ii, p. 92, pl. ix (xvii), figs. 22—25.

— — var. of Planorbulina farcta, *Goës*, 1882. K. Sven. Vet.-Ak. Handl., vol. xix, No. 4, p. 96.

Planorbulina (Truncatulina) variabilis, *Brady*, 1882. Proc. R. Soc. Edinb., vol. xi, p. 712.

Truncatulina variabilis, *Brady*, 1884. Report 'Challenger,' p. 661, pl. xciii, figs. 6, 7.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 189—191.

TRUNCATULINA VARIABILIS, *Woodward*, 1885. Journ. N. York Micr. Soc., vol. i, p. 151.
— — *Millett*, 1886. Trans. Geol. Soc. Cornwall, vol. x, p. 226.
— — *B., P., and J.*, 1888. Tr. Zool. Soc., vol. xii, pt. 7, p. 227, pl. xlv, fig. 17.
— — *Terrigi*, 1889. Mem. Acc. Lincei, ser. 4, vol. vi, p. 116, pl. vii, figs. 8, 9.
— — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 562, pl. xi, fig. 22.
— — *Chapman*, 1892. Quart. Journ. Geol. Soc., vol. xlviii, p. 517; and vol. l, 1894, p. 721.
— — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 404, pl. xvi, figs. 57—59, 63, 64.
PLANORBULINA VARIABILIS, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 88.
TRUNCATULINA LOBATULA, var. VARIABILIS, *De Amicis*, 1895. Nat. Sicil., Ann. xiv, p. 52.
— VARIABILIS, *Fornasini*, 1896. Rivista Italiana di Paleontologia, fasc. di Aprile, 1896, pp. 1—5, and fig. (= Costa's *Trunc. innormalis*).

Character.—In shell-structure similar to *Truncatulina lobatula*, but losing its relatively spiral arrangement in a wild-growing irregularity of the chambers in an apparently infinite variety of forms.

Occurrence.—This varietal form of *T. lobatula* has a geographical and bathymetrical range corresponding with the type. Its earliest recorded appearance as a fossil is from the Neocomian (Bargate beds of Surrey); it has also been found in the Gault, the Red Chalk, the Phosphatic Chalk of Taplow; the Miocene of Bavaria and Muddy Creek (Victoria), the Pliocene of Italy and St. Erth. In the Coralline Crag it is found somewhat rarely in every zone we have examined.

4. TRUNCATULINA HAIDINGERI (*d'Orbigny*), 1846. Plate IV, fig. 18.

Part I, 1866, Appendices I and II, Tables, No. 80.

(?) ROTALIA PROPINQUA (*von Münst.*), *Römer*, 1838. Neues Jahrb. für Min., &c., p. 389, pl. iii, fig. 54.
ROTALINA HAIDINGERI, *d'Orbigny*, 1846. For. Foss. Vien., p. 154, pl. viii, figs. 7—9.
— EHRENBERGII, *Baily*, 1851. Smithsonian Contrib., vol. ii, art. 3, p. 10, figs. 11—13.

Rotalia Brueckneri, *Reuss*, 1855. Zeitschr. deutsch. geol. Gesellsch., vol. vii, p. 273, pl. ix, fig. 7.

— propinqua, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 241, pl. iv, fig. 53.

Rotalina propinqua, *Egger*, 1857. Neues Jahrb. für Min., &c., p. 275, pl. vii, figs. 14—17.

Rotalia Haidingeri, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 104.

Rotalina Haidingeri, *Karrer*, 1861. Sitz. k. Ak. Wiss. Wien, vol. xliv, p. 455, No. 124.

— — — 1864. Ibid., vol. l, p. 719, No. 133.

Rotalia scutellaris, *Karrer*, 1864. Ibid., p. 709, pl. ii, fig. 13.

— propinqua, *Reuss*, 1864. Ibid., p. 475.

— perforata, *Karrer*, 1864. Novara-Exped., vol. i, Paläont. Abtheil., p. 81, pl. xvi, fig. 13.

Planorbulina Haidingeri, *Jones and Parker*, 1864. Geologist, vol. vii, pp. 87, 89.

— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 469, pl. xlviii, fig. 11.

— farcta, var. Haidingerii, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 382, pl. xvi, figs. 22 *a*, *b*.

— Haidingerii, *P., J., and B.*, 1866. Monogr. Foram. Crag, App. i and ii, No. 80, pl. iv, fig. 18.

Truncatulina Haidingeri, *Reuss*, 1867. Sitzungsb. Ak. Wiss. Wien, vol. lv, pp. 28, 100.

— — *Karrer*, 1868. Ibid., vol. lviii, p. 180.

Planorbulina Haidingeri, *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 359.

Truncatulina Haidingeri, *Fuchs and Karrer*, 1871. Jahrb. k. k. geol. Reichsanst., vol. xxi, p. 76.

Planorbulina Haidingerii, *Terrigi*, 1880. Atti Accad. Pontif. N. Lincei, ann. xxxiii, p. 202, pl. ii, fig. 48.

Truncatulina Haidingerii, *Brady*, 1884. Report 'Challenger,' pp. 127 and 663, pl. xcv, figs. 7 *a*—*c*.

— — — 1887. Journ. R. Micr. Soc., p. 921.

— Haidingeri, *Toutkowski*, 1888. Zap. Kievsk., vol. ix, p. 50, pl. viii, figs. 3 *a*—*c*.

— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 401, pl. xvi, figs. 25—27.

— Haidingerii, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 446.

— — *Fornasini*, 1894. For. Coll. Sold., Sagg. Oritt., p. 9.

— — *De Amicis*, 1895. Nat. Sicil., ann. xiv, pp. 53 and 63.

— (Rotalina) Haidingeri, *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 29, pl. v, figs. 1 *a*—*c*.

Characters.—Shell orbicular, formed of from three to four revolutions of a spire, each consisting of six or seven chambers. Aboral surface more or less trochoid; the other (oral or inferior) face subconvex, often excavated at the umbilicus; formed of about six triangular chambers extending from the periphery to the umbilicus. Margin blunt, scarcely angular. Foramina numerous and conspicuous over every part of the shell.

Between the neat, well-defined, highly trochoid shell figured by d'Orbigny and the somewhat clumsy, indefinite examples of the same species found in the Crag there seem, at first sight, to be few characters in common; yet there need be no hesitation in regarding them as the same form. It is rare under any circumstances to meet with specimens so distinct in all external characters as the figures in the "Vienna Basin" monograph indicate; and, on the other hand, the few which have been found in the Crag (from Sutton and Sudbourne), though of average size, have their structure obscured either by the thickening of the shell wall from age, or by the mechanical effect of attrition.

Occurrence.—*Truncatulina Haidingeri* is not of frequent occurrence in the recent condition, though it has a wide range geographically. It has been found at various depths down to 1776 fathoms ('Challenger' Report) and 2140 fathoms ('Gazelle').

In the fossil condition it appears to be more common. Specimens have been found in the Neocomian (Bargate beds of Surrey); the Eocene (London Clay and Calcaire Grossier); the Miocene of Malaga, Italy, Vienna, and Muddy Creek (Victoria); and the Pliocene of Italy, Garrucha, and St. Erth. In the Coralline Crag we have found examples in nearly every zone examined.

5. TRUNCATULINA UNGERIANA (*d'Orbigny*), 1846. Plate II, figs. 11, 12.

Part I, 1866, Appendices I and II, Tables, No. 79.

Ammoniæ *univolutæ, Soldani*, 1780. Saggio Orittogr., p. 103, pl. iii, figs. 22, *h*, *H*, *I*.

Hammoniæ *Univolutæ*, *Soldani*, 1798. Testaceographia, vol. ii, App., p. 139, pl. iii, figs. 22 *h*, *H*, *I*.

ROTALIA (TURBINULINA) SIENNENSIS (?), *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 275, No. 50.

ROTALINA UNGERIANA, *d'Orb.*, 1846. For. Foss. Vienn., p. 157, pl. viii, figs. 16—18.

— SEMIPUNCTATA, *Bailey*, 1851. Smithsonian Contrib., vol. ii, art. 3, p. 11, figs. 17—19.

— UNGERIANA, *Reuss*, 1851. Zeitsch. geol. deutsch. Ges., vol. iii, p. 76.

— — *Bornemann*, 1855. Ibid., vol. vii, p. 341, pl. xvi, fig. 5.

ROTALINA ROEMERI, *Reuss*, 1855. Sitz. k. Ak. Wiss. Wien, vol. xviii, p. 240, pl. iv, figs. 52 *a—c*.

ROTALIA UNGERIANA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 105.

— INVOLUTA (var.), *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien, vol. xliv, p. 313, pl. ii, fig. 4.

— MORTONI, *Reuss*, 1861. Ibid., p. 337, pl. viii, fig. 1 (thick variety).

PLANORBULINA UNGERIANA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 469, pl. xlviii, fig. 12.

— — *Jones and Parker*, 1864. Geologist, vol. vii, pp. 87, 89.

ROTALIA MACULATA, *Stache*, 1864. Novara-Exped., vol. i, Paläont. Abtheil., p. 278, pl. xxiv, fig. 28.

ROSALINA THIARA, *Stache*, 1864. Ibid., p. 279, pl. xxiv, fig. 29.

— — var. ELATIOR, *Idem*, 1864. Ibid., fig. 30.

PLANORBULINA FARCTA, var. UNGERIANA, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 382, pl. xvi, figs. 23—25.

TRUNCATULINA UNGERANA, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 161, No. 10.

PLANORBULINA UNGERIANA, *P., J., and B.*, 1866. Monogr. For. Crag, App. i and ii, No. 79, pl. ii, figs. 11, 12.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 355.

— — *Anon.*, 1870. Sci. Gossip, p. 10, fig. 22.

TRUNCATULINA UNGERANA, *Reuss*, 1870. Sitz. k. Ak. Wiss. Wien, vol. lxii, p. 490, No. 3; and *Schlicht*, 1870, Pietzpuhl, pl. xxi, figs. 1—3.

PLANORBULINA UNGERIANA, *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, p. 174, No. 78, pl. xii, fig. 130.

PLANORBULINA UNGERIANA, *Morris*, 1876. Lect. Geol. Croydon, p. 8, fig. 2[1].

— — *Terrigi*, 1880. Atti Acc. Pont. N. Lincei, vol. xxxiii, p. 203, pl. iii, fig. 53.

TRUNCATULINA UNGERIANA, *Hantken* (1875), 1881. Mitth. Jahrb. Ung. Geol. Anstalt, vol. iv, p. 72, pl. viii, figs. 7 *a*, *b*.

PLANORBULINA UNGERIANA, *Goës*, 1882. K. Sven. Vet.-Ak. Handl., vol. xix, No. 4, p. 100, pl. vii, figs. 234—236.

— — var. AFFIXA, *Goës*, 1882. Ibid., p. 103, pl. vii, figs. 237—241.

TRUNCATULINA UNGHERANA [UNGERIANA], *Hantken*, 1883. Ertekez., &c., vol. xiii, No. 1, p. 12; 1884, Math. u. Nat. Berichte Ungarn, vol. ii, p. 133.

— UNGERIANA, *Brady*, 1884. Report 'Challenger,' p. 664, pl. xciv, figs. 9 *a—c*.

PLANORBULINA UNGERIANA, *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc., ser. 2, vol. vi, p. 757, pl. xvi, figs. 16 *a—c*.

TRUNCATULINA UNGERIANA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 144.

— — *Brady*, 1887. Journ. R. Micr. Soc., p. 921.

— — *A. Agassiz*, 1888. Voy. 'Blake,' vol. ii, p. 169, fig. 518.

TRUNCATULINA INVOLUTA, *Franzenau*, 1889. Math. u. Naturw. Berichten aus Ungarn, vol. vii, p. 263, pl. iv, fig. 4.
ROTALIA, sp., *Beissel*, 1891. Abhandl. K. Preuss. Geol. Landes., n. s., part 3, p. 73, pl. xiv, figs. 20—24 (thick variety).
TRUNCATULINA UNGERIANA, *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 106, pl. iv, fig. 9.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 447.
— — *A. Silvestri*, 1893. Atti Rendic. Accad. Sci. Lett. Arti Zelanti Acireale, vol. v, p. 19, pl. iv, figs. 39—41.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, part 2 (not descr.), pl. xvi, figs. 19—21.
PLANORBULINA UNGERIANA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 90, pl. xv, fig. 780.
TRUNCATULINA UNGERIANA, *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 53 and 63.
PLANORBULINA UNGERIANA, *Goës*, 1896. Bull. Mus. C. Z., Harvard Coll., vol. xxix, p. 71.

Characters.—Shell free, orbicular, depressed; consisting of about three revolutions in a complanate spire; aboral side convex, depressed at the umbilicus; oral surface nearly flat; periphery thin, often acutely carinate. Chambers numerous (8—12), convex, extending to the umbilicus, and bounded by sinuous septal lines on the aboral side. Foramina generally very numerous and conspicuous; oral surface of the shell often granular.

The regular *Planorbulinæ* present so unbroken a series that it must always be a matter of individual judgment, rather than one of strict rule, how its subdivision should be effected. Hence, out of deference to the opinion of other authors, we have presented a somewhat limited synonym of *P. Ungeriana*, else we know of no permanent characters which would have precluded our adding *P. Akneriana* and many other so-called species to the list; for example, *Rotalina tuberculifera*, Reuss, *Rotalia granosa*, Reuss, *Truncatulina horrida*, Karrer, which differ from the normal form in their increased tendency to a granular or tubercular condition, especially of the lower surface.

Occurrence.—*Truncatulina Ungeriana* has a wide geographical and bathymetrical range. The 'Challenger' Report records its occurrence in the North and South Atlantic, the North and South Pacific, and the Mediterranean. We have numerous specimens in our own Collection from the Indian Ocean.

In a fossil condition it has been recorded from the Cretaceous of Swanscombe, Kent; the Eocene (London Clay); the Oligocene of Germany; the Miocene of Malaga, Italy, Vienna, and Muddy Creek (Victoria), and the Pliocene of Garrucha (Spain), Italy, and St. Erth. In the Coralline Crag we have it from every zone examined.

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PALÆONTOGRAPHICAL SOCIETY.

T. Rupert Jones
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Part IV

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A MONOGRAPH

OF THE

FORAMINIFERA OF THE CRAG.

PART IV.

CONTAINING

Pages xiii—xv; General Title-page; vii—xv; 315—402.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

HON. MEM. GESELL. ISIS DRESDEN, SOC. BELG. MICROSC., AND SOC. GÉOL. PALÉONTOL. HYDROL. BRUX., GEOL. ASSOC. LOND., GEOL. SOCS. EDIN., GLASG., ROY. IRISH GEOL. SOC., AND ANTHROP. INST. LOND.; CORRESP. MEM. OF THE K.-K. GEOLOG. REICHSANSTALT. VIENNA, AND ACAD. NAT. SCI. PHILAD., ETC.

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CONTENTS OF PART IV.

LIST OF GENERA AND SPECIES DESCRIBED AND FIGURED IN PART IV.

WOODCUTS IN PART IV.

CORRECTIONS FOR PART IV.

Page 315, after line 16 from the top, *insert* HETEROLEPA, *Franzenau.*

„ „ after line 5 from the bottom, *insert* HETEROLEPA GROSSERUGOSA, *Franzenau*, 1885. 'Természetrajzi Fuzetek' (Budapest), vol. ix, p. 93, pl. vii, fig. 2.

„ 329, line 11 from bottom, *for* Magt. Klein. *read* Magt van het Kleine,

„ 333 „ 10 from the top, *add* Mr. Millett has it from the St.-Erth beds.

„ 337, *insert* additional synonyms of NONIONINA:

ROTALINA, *Williamson.*

ROTALIA, *von Reuss.*

PULLENIA, *von Hantken.*

ANOMALINA (?), *Schwager.*

PULVINULINA, *Andreae.*

For ROBULINA add *Kübler and Zwingli.*

For POLYSTOMELLA add *Goës.*

„ 343, line 7 from bottom, *after* nov. insert *Jones.*

Genus 4.—ANOMALINA, *d'Orbigny*, 1826.

Brady, 1884, *Report 'Challenger,' pp.* 73, 627, 671.

ANOMALINA, *d'Orbigny, Bronn, von Münster, Römer, von Reuss, Costa, Parker and Jones, Egger, Carpenter, Karrer, Seguenza, Brady, M. Sars, von Schlicht, Siddall, Martonfi, Schwager, von Gümbel, Berthelin, Terquem, Basset, Sherborn and Chapman, Nicolucci, Franzenau, Bütschli, Walther, Sander Rang, Williamson, Schrodt, De Amicis, A. Silvestri,* and others.
PLANULINA, *d'Orbigny, Bronn, Münster, Römer, von Reuss, Norman.*
ROTALINA, *d'Orbigny.*
ROSALINA, *von Reuss, Stache.*
ROTALIA, *von Reuss, Stache, von Gümbel.*
NONIONINA, *von Reuss.*
DISCORBINA, *von Reuss, Seguenza.*
PLANORBULINA, *Parker, Jones, Brady, von Reuss, Wright.*
TRUNCATULINA, *von Gümbel, von Hantken.*

General Characters.—Test free, rotaliform or subnautiloid; the two faces subconcave and nearly alike; the upper face shows a nearly plain spire of many chambers; the lower face has fewer chambers and a deeper umbilicus. Aperture a nearly symmetrical slit at the base of the last chamber.

1. ANOMALINA GROSSERUGOSA (*Gümbel*), 1868, variety. Plate VII, figs. 30 *a*—*c*.

Synonyms of the Type-form :

TRUNCATULINA GROSSERUGOSA, *Gümbel*, 1868. Abhandl. k. bayer. Akad. Wiss., vol. x, p. 660, pl. ii, figs. 104 *a*—*c*.
— — *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anstalt, vol. iv, p. 74, pl. ix, figs. 6 *a*—*c*.
— GRANOSA, *Hantken*, 1875. Ibid., vol. iv, p. 74, pl. x, figs. 2 *a*—*c*.
ANOMALINA GROSSERUGOSA *Brady*, 1884. Report 'Challenger,' p. 673, pl. xciv, figs. 4 *a*—*c*, 5 *a*—*c*.
— — *Sherborn and Chapman*, 1889. Journ. R. Micros. Soc. for 1889, p. 487, pl. xi, fig. 34.
— — *Burrows, Sherborn, and Bailey*, 1890. Ibid., 1890, p. 563, pl. xi, figs. 25 *a*, *b*.

Rosalina, sp., *Beissel*, 1891. Abhandl. k. Preuss. Geol. Landes., n. s., part 3, p. 75, pl. xvi, figs. 17—22.
Anomalina grosserugosa, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 450.
— — *Chapman*, 1895, Proceed. Zool. Soc., 1895, p. 41.

Characters.—Subnautiloid in shape, unequally concave on the two faces. Less symmetrical than *A. ammonoides*, Reuss, and, like it, subject to variation in details.

Our figured specimen appears to be rather thicker than Gümbel's and thinner than Brady's figures, and shows fewer chambers than either. Von Hantken's figure shows a close alliance with ours; and that given by B., S., and B. is thicker than our specimen, and has its aperture contracted and more medial.

There are several published figures of varieties of this form:—*Rosalina rudis*, Gümbel (1868), is possibly the same; and with the two faces equally convex there are *Anomalina moniliformis*, Reuss (1845), and *Truncatulina pusilla*, Deecke (1886).

Occurrence.—Found living here and there in the Atlantic and Pacific at depths ranging from 345 to 2160 fathoms. It occurs fossil in Eocene strata in the Bavarian Alps, and in the London Basin; and in the Miocene of Hungary.

Genus 5.—Pulvinulina, *Parker and Jones*, 1862.

Carpenter, '*Introd. Foram.*,' 1862, p. 210; *Brady*, *Report* '*Challenger*,' 1884, pp. 73, 627, 681.

Nautilus, *Soldani*, *Fichtel and Moll.*
Serpula, *Montagu.*
Cidarollus, Eponides, and Cancris, *de Montfort.*
Pulvinulus, *Lamarck.*
Cristellaria, *Lamarck.*
Placentula, *Lamarck*, *Berthelin.*
Crepidulina, *Blainville and Defrance.*
Rotalites, *Blainville and Defrance.*
Rotalia, *d'Orbigny*, *von Reuss*, *Parker and Jones*, *Morris and Quekett*, *Karrer*, *Schwager*, *von Gümbel.*
Rosalina, *d'Orbigny*, *Parker and Jones*, *von Gümbel*, *and Terquem.*
Turbinulina and Planorbulina, *d'Orbigny.*
Omphalophacus, *Ehrenberg.*
Rotalina, *d'Orbigny*, *von Reuss*, *Czjzek*, *Bailey*, *Ehrenberg*, *Bornemann*, *Egger*, *Williamson*, *Karrer*, *Seguenza*, *Alcock*, *Terquem*, *Parfitt*, *von Schlicht*, *Schlumberger.*

VALVULINA, *d'Orbigny*, *Terquem*.
GYROIDINA, *Römer*.
PLANULINA, *Römer*, *Ehrenberg*.
PLATYŒCUS and SPIROPLEURITES, *Ehrenberg*.
PULVINULINA, *Parker and Jones*, *Carpenter*, *Brady*, *S. Owen*, *von Reuss*, *Karrer*, *M. Sars*, *von Hantken*, *Dawson*, *Fischer*, *Miller and Vanden Broeck*, *Schulze*, *Norman*, *Blake*, *Wright*, *Siddall*, *Terrigi*, and others.
DISCORBINA, *Schwager*, *Seguenza*.
TRUNCATULINA, *Karrer*, *Seguenza*.
EPISTOMINA, *Terquem*, *Uhlig*.

General Characters.—Rotaliform; "superior" face generally thicker; shell usually very finely porose; chambers fewer than in other Rotalines; sutures usually thickened; aperture variable, typically a large slit at the umbilical margin of the last chamber.

1. PULVINULINA REPANDA (*Fichtel and Moll*), 1803. Plate II, figs. 25—27 ("*P. pulchella*").

Part I, 1866, Appendices I and II, Tables, No. 84 ("*P. pulchella*").

NAUTILUS REPANDUS, *Fichtel and Moll*, 1803. Testac. Micros., p. 35, pl. iii, figs. *a*—*d*.
EPONIDES REPANDUS, *Montfort*, 1808. Conchyl. Systèm., vol. i, p. 126, 32e genre.
PULVINULUS REPANDUS, *Lamarck*, 1816. Tabl. Encycl. Méth., pl. cccclxvi, figs. 9 *a*—*d*.
PLACENTULA PULVINATA, *Lamarck*, 1822. Anim. Sans Vert., vol. vi, p. 621, No. 1.
— — *Defrance*, 1824 (fide *Blainville*). Dict. Sci. Nat., vol. xxxii, p. 180; vol. xli, p. 193; Atlas Conch., pl. xv, fig. 5.
— — *Blainville*, 1825. Manuel Malacol., p. 374, pl. vii, fig. 5.
ROTALINA CONCAMERATA, *Williamson*, 1858. Rec. For. Gt. Br., p. 52, pl. iv, figs. 101—103.
ROTALIA REPANDA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 110, Table.
— — *Parker and Jones*, 1860. Ann. Nat. Hist., ser. 3, vol. v, p. 175, No. 25; p. 290, No. 42; vol. vi, p. 341, No. 18.
PULVINULINA REPANDA, *Parker and Jones*, 1862. In Carpenter's Introd., App., p. 311.
— — — 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 215, No. 106.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 78.

Pulvinulina repanda, *Parker and Jones*, 1865. Phil. Trans., vol. clv, pp. 390—393.
Rotalina concamerata, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.
Pulvinulina repanda, *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 359, &c.
Rotalina concamerata, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
Placentula repanda, *Berthelin*, 1878. Ann. Soc. Acad. Nantes, ser. 5, vol. viii, Reprint, p. 41, No. 68.
Pulvinulina repanda, *Terrigi*, 1880. Atti Accad. Pontif. N. Lincei, vol. xxxiii, p. 206, pl. iii, fig. 61.
— — *Goës*, 1882. K. Sv. Vet.-Ak. Handl., vol. xix, No. 4, p. 110, pl. viii, figs. 276—282.
— — *Terrigi*, 1883. Att. Acc. P. N. Lincei, p. 198, pl. iii, fig. 42.
— — *Brady*, 1884. Report 'Challenger,' pp. 627, 684, pl. civ, figs. 18 *a*—*c*.
— — *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., p. 757, pl. xvi, figs. 18 *a*—*c*.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 164.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 921.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 405, pl. xviii, figs. 34—36.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 95, pl. xvi, figs. 801 *a*, *b*.
— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 55 and 63.

Characters.—The typical *Pulvinulina repanda* has a trochoid or discoidal shell, formed of about two and a half revolutions, all visible on the upper (spiral) surface, the outermost alone visible on the lower. Outermost convolution consisting of six or eight slightly convex segments. Septa (in normal specimens) on the upper surface more or less limbate, the raised line of shell-substance prolonged round the external margin of the segments forming an obtuse peripheral carina. On the inferior surface segments convex, especially the later ones; septa depressed, often obscure; surface sometimes tuberculate, sometimes marked by large perforations, radiating from the irregular umbilicus. Peripheral margin almost entire, sometimes lobulate, the peripheral convexity of the ultimate and penultimate segments being most prominent.

The figured specimen (Pl. II, figs. 25—27), shows one of the modifications which have fewer chambers than the large forms and are more compact, forming a more or less conical shell, with neatly limbate sutures on the aboral face. It is near *P. pulchella* (d'Orb., 1829), but of stronger build.

Occurrence.—*Pulvinulina repanda*, according to the 'Challenger' Report, is a shallow-water form commonly found at depths ranging from the shore-line down to 200 fathoms, and sparingly down to 1000 fathoms. Egger, in the 'Gazelle'

Memoir, records specimens from several stations at depths exceeding 1000 fathoms—his lowest record being 2740 fathoms. Geographically the range of the species is wide, but it is most commonly met with in tropical and subtropical latitudes.

Fossil specimens have been recorded from the Chalk of Swanscombe and Taplow; from the Eocene (London Clay); from the Miocene of Italy and Muddy Creek, Victoria; the Pliocene of Italy; and the Pleistocene of Norway. In the Coralline Crag we have found specimens in nearly every zone examined.

2. Pulvinulina punctulata (*d'Orbigny*), 1826. Plate II, figs. 22—24 ("*P. repanda*").

Part I, 1866, Appendices I and II, Tables, No. 83 ("*P. repanda*").

Rotalia punctulata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 273, No. 25, Modèle, No. 12.
Rosalina calabra, *Costa*, 1856. Atti Accad. Pont., vol. vii, part 2, pl. xiv, fig. 6.
— vesicularis, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 292, pl. x, figs. 22—24.
Pulvinulina repanda, var. punctulata, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 394, pl. xiv, figs. 12, 13.
— punctulata, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 20, pl. iii, fig. 82.
— repanda, *J., P., and B.*, 1866. Monogr. Foram. Crag, pl. ii, figs. 22—24.
— punctulata, *Brady*, 1884. Report 'Challenger,' pp. 683, 685, pl. civ, figs. 17 *a—c*.
— — var., *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 758, pl. xvi, figs. 22 *a—c*; 23 *a—c*.
? Rosalina d'Orbignyi, *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, p. 382, pl. xx, figs. 12 *a—c*.
Pulvinulina punctulata, *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 96, pl. xvi, figs. 797—800.
— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 43.

Characters.—A large but somewhat depressed, modified form of *P. repanda*, with inflated segments and non-limbate sutures; the inferior (umbilical) face is sunken, and usually has many large perforations, and sometimes a few tubercles. It is one of the largest of the rotaliform Foraminifera.

The Crag specimens are distinguished from the typical *Pulvinulina repanda* by their comparatively enormous size, complanate shape, and inflated segments,

together with the somewhat peculiar perforation of the shell-wall on the lower surface.

Occurrence.—Living at depths of from 60 to 290 fathoms in the North Atlantic, Mediterranean, and Adriatic, and at one spot off the west coast of Patagonia. It is a known fossil in the London Clay, the Crag of Suffolk, the Pliocene of Italy, and the Post-Tertiary of Norway.

Amongst Messrs. Crosskey and Robertson's gatherings from the Glacial Clay (Post-Tertiary) of the coast of Norway, examples precisely similar to those found in the Crag occur. It is a matter of some interest in connection with these fossils that the genus *Pulvinulina*, though well represented over a large portion of the area of the British seas, is almost unknown as a recent Foraminifer on our eastern coast, neither does it occur amongst the sub-fossilised microzoa of the Fens.

The large specimens—such as our figures are taken from—are in Mr. Searles Wood's Collection from Sutton; smaller examples were found in the Polyzoan débris from Sudbourne.

3. Pulvinulina auricula (*Fichtel and Moll*), 1803. Plate II, figs. 33—35.

Part I, 1866, Appendices I and II, Tables, No. 85.

Hammoniæ subconicæ, &c., *Soldani*, 1789. Testaceographia, vol. i, part 1, p. 56, pl. xxxviii, fig. ii; p. 61, pl. l, fig. v.

Nautilus auricula, *Fichtel and Moll*, 1803. Testac. Microscop., p. 108, var. *a*, pl. xx, figs. *a*—*c*.

Cancris auriculatus, *Montfort*, 1808. Conchyl. Syst., vol. i, p. 266, 67e genre.

Cristellaria auricula, *Lamarck*, 1822. Anim. Sans Vert., vol. vii, p. 608, No. 4.

Crepidulina auricula, *Defrance* (fide *Blainville*), 1824. Dict. Sci. Nat., vol. xxxii, p. 188.

Nonionina auricula, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 295, No. 24.

Rotalia Brongniartii, *d'Orbigny*, 1826. Ibid., p. 273, No. 27.

Valvulina excavata, *d'Orbigny*, 1839. Foram. Canaries, p. 137, pl. i, figs. 43—45.

Rotalina sagra, *d'Orbigny*, 1839. Foram. Cuba, p. 77, pl. v, figs. 13—15.

— Brongniartii, *d'Orbigny*, 1846. For. Foss. Vienne, p. 158, pl. viii, figs. 22—24.

— — *Egger*, 1857. Neues Jahrb. für Min., Jahrg. 1857, p. 274, pl. vii, figs. 5—7.

— oblonga, *Williamson*, 1858. Rec. For. Gt. Br., p. 51, pl. iv, figs. 98—100.

— — *Dawson*, 1860. Canad. Nat., vol. v, p. 191, fig. 1.

ROTALIA AURICULA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 117 (Table).
— — *Parker and Jones*, 1860. Ann. Nat. Hist., ser. 3, vol. v, p. 177, No. 27.
— REPANDA, var. AURICULA, *P. and J.*, 1860. Ibid., p. 289, No. 66.
— AURICULA, *P. and J.*, 1860. Ibid., vol. vi, p. 344, No. 52.
— CONTRARIA, *Reuss*, 1861. Sitzungsb. Ak. Wiss. Wien, vol. xlii, p. 358.
— — — 1862. Bullet. Acad. Roy. Belg., ser. 2, vol. xv, p. 154, No. 51.
PULVINULINA AURICULA, *Parker and Jones*, 1862. Carpenter's Introd., p. 311, Appendix.
— — *P. and J.*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 202, No. 5.
— REPANDA, var. AURICULA, *P. and J.*, 1863. Ibid., p. 433, No. 21.
— AURICULA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 79.
ROTALINA OBLONGA, *Alcock*, 1865. Proc. Lit. and Phil. Soc. Manch., vol. iv, p. 206.
PULVINULINA AURICULA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 393.
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append., No. 85, pl. ii, figs. 33—35.
ROTALINA OBLONGA, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
PULVINULINA AURICULA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.
— CONTRARIA, *Reuss*, 1870. Sitzungsb. k. Ak. Wiss. Wien, vol. lxii, p. 490, No. 3.
ANOMALINA, No. 376, *Schlicht*, 1870. Pietzpuhl, p. 65, pl. xxii, figs. 10—13.
PULVINULINA AURICULA, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 173, No. 75.
— — *Terrigi*, 1880. Att. Acc. P. N. Lincei, vol. xxxiii, p. 206, pl. iii, fig. 58.
VALVULINA OVALIS, *Terquem*, 1882. Mém. Soc. Geol. France, ser. 3, vol. ii, Mém. iii, p. 103, pl. xix, fig. 10.
PULVINULINA AURICULA, *Goës*, 1882. Svensk. Vet. Ak. Handl., vol. xix, No. 4, p. 109, pl. viii, figs. 273—275.
— — *Brady*, 1884. Report 'Challenger,' p. 688, pl. cvi, figs. 5 *a*—*c*.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 164—166, 170, 173, 198.
— — *Malagoli*, 1887. Atti Soc. Nat. Modena, ser. 3, vol. iii, p. 110, pl. i, fig. 16.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 922.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. viii, p. 415, pl. xvii, figs. 26—28.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 98, pl. xvi, figs. 809, 810.
— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 19.

PULVINULINA AURICULA, *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 224, pl. iii, figs. 43, 43 *a*, 43 *b*.
— — *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 55 and 63.
— — *Chapman*, 1895, Proceed. Zool. Soc., 1895, p. 43.
— — *Goës*, 1896. Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix, p. 77.

Characters.—Shell oblong, depressed, inequilateral, consisting of rather less than two convolutions, both of which are visible superiorly; the outermost consists of about eight or nine arcuate segments, which increase rapidly in length as they approach the end. Superior (spiral) surface smooth, almost flat; the segments scarcely ventricose. Inferior surface convex; segments more ventricose, especially the last, from the narrow end of which a small lamina projects covering the inferior umbilicus. Septal lines on the lower surface somewhat excavated, especially near the umbilicus. Periphery slightly lobulate, angular or carinate. Orifice narrow, crescentic, on the inner border of the ultimate segment, close to the preceding convolution.

Occurrence.—*Pulvinulina auricula* is found in tropical and temperate seas at depths ranging from 17 to over 500 fathoms.

Fossil specimens have been obtained from the Eocene (Calcaire Grossier); the Oligocene of Pietzpuhl; the Miocene of Muddy Creek, Victoria; the Pliocene of Garrucha and St. Erth; and the Pleistocene of Italy and elsewhere. In the Coralline Crag we have met with it at Tattingstone, zone **d**. Mr. Searles Wood found some medium-sized specimens in his Sutton gatherings, and one or two examples, of really large dimensions, were subsequently met with in material from the same locality. The figured specimens (figs. 33—35) are about equal to such as have been found off the Scilly Isles and Ushant, at 50—70 fathoms.

4. PULVINULINA KARSTENI (*Reuss*), 1855. Plate II, figs. 28—30.

Part I, 1866, Appendices I and II, Tables, No. 86.

ROTALIA KARSTENI, *Reuss*, 1855. Zeitschr. Deutsch. Geol. Gesel., vol. vii, p. 273, pl. ix, fig. 6.
PULVINULINA KARSTENI, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 15.
— REPANDA, var. KARSTENI, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 396, pl. xiv, figs. 14, 15, 17; pl. xvi, figs. 38—40.
— KARSTENI, *J., P., and B.*, 1866. Monogr. Foram. Crag, Append., No. 86, pl. ii, figs. 28—30.

PULVINULINA KARSTENI, *Sars*, 1868. Vidensk.-Selsk. Forhandl. for 1868, p. 248.
— — *Brady*, 1878. Ann. Mag. Nat. Hist., ser. 5, vol. ii, p. 436, pl. xxi, fig. 11.
— CANDIDULA, *Schwager*, 1883. Palæontogr., vol. xxx, p. 133, pl. xxviii, fig. 10.
— KARSTENI, *Brady*, 1884. Report 'Challenger,' p. 698, pl. cv, figs. 8, 9.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 97, pl. xvi, fig. 807.
— — *De Amicis*, 1895. Nat. Sicil., ann. xiv, p. 55.
— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 43.

Characters.—Shell many-chambered, compact. Upper (spiral) surface conical, smooth, and free from limbation. Lower surface convex, umbonate; septa and margin limbate. Periphery slightly lobulate.

Pulvinulina Karsteni is the small, comparatively thick, many-chambered modification of the type which seems to find a place between *P. Menardii* and *P. Schreibersii.* The wheel-like appearance of the lower surface imparted by the somewhat thickened umbo and slightly limbate sutures and margin (the upper surface retaining the normal smooth condition) is sufficiently characteristic in well-developed specimens. These characters, however, are so often more or less wanting that the species is frequently very difficult to identify.

Our figured specimen is such as has been recorded ('Phil. Trans.,' vol. clv, Table VII, p. 422), very rare and very small, in the Peterborough fens. Larger specimens occur at the Hunde Islands, in the Arctic region, and these approach closely the varieties met with in the Lias and Oolite, and these latter pass insensibly into *P. elegans*, and from that into *P. caracolla.*

Occurrence.—*Pulvinulina Karsteni* appears to be typically an Arctic form. According to the 'Challenger' Report it has not been met with south of lat. 38° 34′ in the Northern Hemisphere, and in the Southern Hemisphere north of lat. 26° 45′. This is corroborated by the total absence of the species in the gatherings of the 'Gazelle.' Fossil specimens have been recorded from the Neocomian (Bargate Beds) of Surrey, from the Phosphatic Chalk of Taplow, and from the Chalk of Mecklenburg; from the Eocene (London Clay); from the Pliocene of Italy and St. Erth; the Pleistocene of Italy and Britain. In the Coralline Crag we have one specimen from Tattingstone, zone d. It was recorded in the First Part of the Monograph from the Upper Crag of Southwold.

5. PULVINULINA ELEGANS (*d'Orbigny*), 1826. Plate VII, figs. 32 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 87.

Nautili *Ammoniformes*, sive *trochiformes*, *Soldani*, 1780. Saggio Oritt., p. 99, pl. ii, figs. 13 *q*, *Q*, *R*.
Nuclei *Ammoniformes*, sive *trochiformes*, *Soldani*, 1798. Testaceographia, vol. ii, App., p. 138, pl. ii, figs. 13 *q*, *Q*, *R*.
ROTALIA (TURBINULINA) ELEGANS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 276, No. 54.
ROTALINA PARTSCHIANA, *d'Orbigny*, 1846. For. Foss. Vien., p. 153, pl. vii, figs. 28–30; pl. viii, figs. 1—3.
— — *Reuss*, 1851. Zeitschr. deutsch. geol. Gesel., vol. iii, p. 74.
ROTALIA ELEGANS, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 305, No. 114; p. 455, pl. xx, fig. 46.
ROTALINA PARTSCHIANA, *Karrer*, 1861. Sitzungsb. k. Ak. Wiss. Wien, vol. xliv, p. 455.
ROTALIA PARTSCHIANA, *Karrer*, 1863. Ibid., vol. xlviii, pp. 79 and 92.
ROTALINA PARTSCHII, *Karrer*, 1864. Ibid., vol. l, p. 719.
ROTALIA NOVO-ZELANDICA, *Karrer*, 1864. Novara-Exped., vol. i, Palaeont. Abth., p. 80, pl. xvi, fig. 12.
PULVINULINA ELEGANS, *Jones and Parker*, 1864. Geologist, vol. vii, p. 88.
— REPANDA, var. ELEGANS, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 397, pl. xvi, figs. 44—46.
— PARTSCHIANA, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 206.
— ELEGANS, *J., P., and B.*, 1866. Monogr. Foram. Crag, Append. i and ii, Tables, No. 87.
ROTALIA FLOSCULIFORMIS, *Schwager*, 1866. Novara-Exped., vol. ii, Geol. Theil, p. 262, pl. vii, fig. 109.
— SEMIORNATA, *Schwager*, 1867. (In Waagen) Zone des *Ammon. Sowerbyi*, vol. i, p. 661, pl. xxxiv, fig. 20.
ROTALINA PARTSCHIANA, *Karrer*, 1868. Sitz. k. Ak. Wiss. Wien, vol. lviii, p. 186.
PULVINULINA ELEGANS, *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 361.
— PARTSCHIANA, *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanstalt, vol. xxi, p. 71.
— — *Reuss*, 1870. Sitzungsb. k. Ak. Wiss. Wien, vol. lxii, p. 490.
ROTALINA, Nos. 350 and 351, *Schlicht*, 1870. Foram. Pietzpuhl, p. 60, pl. xx, figs. 23—25, 29—31.
PULVINULINA ELEGANS, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., p. 174, pl. xii, fig. 142.
— — *Goës*, 1882. K. Sv. V.-Ak. Handl., vol. xix, No. 4, p. 111, pl. viii, figs. 283—285.

Pulvinulina elegans, *Brady*, 1884. Report 'Challenger,' pp. 684, 699, pl. cv, figs. 4—6.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 141.
— — *B., P., and J.*, 1888. Tr. Zool. Soc., vol. xii, pt. 7, p. 228, pl. xlvi, figs. 2 *a*—*c*.
— — *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, p. 352, pl. xx, fig. 6 ?
Rotalia, cf. Bouei [eana], *Beissel*, 1891. Abhandl. k. Preuss. Landes., n. s., part 3, p. 72, pl. xiv, figs. 25—29.
Pulvinulina elegans, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 453.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. viii, p. 410, pl. xviii, figs. 37—39.
— — *Fornasini*, 1893. Istit. Bologna, vol. iii, 1893, p. 435, pl. iii, figs. 18, 18 *a*, 18 *b*.
— — — 1894. Foram. Coll. Soldani, Sagg. Oritt., pp. 9 and 11.
— — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 97, pl. xvi, fig. 808.
— — *De Amicis*, 1895. Nat. Siciliano, ann. xiv, pp. 55 and 63.
— — *Chapman*, 1895. Proceed. Zool. Soc., 1895, p. 42.
— — *Goës*, 1896. Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix, p. 76.

Characters.—Shell trochoid or biconvex, subcarinate. Upper (spiral) surface more or less conical; lower convex, often umbonate. Septal lines and margin on both sides of the shell in some degree limbate. Septa on the under side arcuate, and usually very oblique.

The distinction between this species and *Pulvinulina Karsteni* is one of some doubt and difficulty. In general terms *P. elegans* may be said to be of larger dimensions, less neatly and compactly made, with an occasional tendency to the limbation of sutures on both surfaces of the shell, and with the septa on the lower surface taking a very oblique direction; whilst *P. Karsteni* is limbate only on its lower surface, and the septa on that side are straight and radial.

Occurrence.—Taking the records of the 'Challenger' and 'Gazelle' Reports together, *Pulvinulina elegans* appears to have an almost world-wide range; but it has apparently not been met with in Arctic and Antarctic seas. The depths from which the 'Challenger' and 'Gazelle' specimens were taken ranged from 37 to 2000 fathoms; but we have specimens in our own collections from the Indian Ocean at a depth of 2694 fathoms.

Fossil specimens have been met with in the Lower and Upper Lias; the Neocomian (Bargate Beds) of Surrey; the Phosphatic Chalk of Taplow (Bucks); the Eocene (London Clay); the Oligocene of Elsass and Pietzpuhl; the Miocene

of Malaga and Italy; and the Pliocene of Italy and St. Erth. In the Coralline Crag we have it from Tattingstone and Sudbourne, zone **d**, and Aldborough, zone **g**.

Genus 6.—Rotalia, *Lamarck*, 1804.

Carpenter, '*Introd. Foram.*,' 1862, *p.* 212; *Brady*, *Report* '*Challenger*,' 1884, *pp.* 73 *and* 702.

Nautilus, *Linné, Walker and Boys, Gaultieri, Martini, Schroeter, Murray, Pulteney, Brookes, Adams, Montagu, Maton and Rackett, Parkinson, Pennant, Dillwyn, Turton, Wood, Brown, Macgillivray*, &c.

Rotalia, *Lamarck, d'Orbigny, Fleming, Bronn, Michelotti, von Hagenow, Macgillivray, Thorpe, Parker and Jones, Reuss, Carpenter, Sowerby, Brady, M. Sars, Schwager, Karrer, Schultze, Hall, Brown, Mackie, Hertwig, Harting, von Zittel, Nicholson, Seguenza, Terrigi, Uhlig, Wright, von Gümbel, Malagoli, Marsson, Quenstedt, Mantell, Dawson, Claus, Phillips, Pilla, Dixon, Vanden Broeck, Pictet, Roemer, von Schlicht, Bailey, Kübler and Zwingli, Michelotti, Fornasini, d'Archiac, Stache, Andreae, Bütschli, Toula, Carter, Basset, A. Silvestri*, and others.

Discorbula, *Lamarck.*

Streblus, *Fischer.*

Gyroidina, *d'Orbigny, Römer, Bronn, Basset.*

Turbinulina, *d'Orbigny, Turton.*

Calcarina, *d'Orbigny, Carpenter, Parker and Jones, Brady.*

Rotalites, *Defrance.*

Asterigerina, *d'Orbigny.*

Rotalina, *d'Orbigny, von Reuss, Czjzek, Bornemann, Williamson, Terquem, Schlumberger, Egger, Karrer, Seguenza, Alcock, von Hantken, Parfitt, von Schlicht, Stewart, Terquem, Norman, Martonfi*, &c.

Rosalina, *d'Orbigny, von Reuss, Costa, Egger, Karrer, von Schlicht*, &c.

Faujasina, *Williamson.*

General Characters.—Shell roughly wheel-shaped (rotaliform), finely porous; with septal limbations and umbilical granulations. Aperture an arched slit, nearly median. Large forms have double septa and interseptal canals.

1. Rotalia Beccarii (*Linné*), 1767. Plate II, figs. 19—21.

Part I, 1866, Appendices I and II, Tables, No. 88.

Small shell, *Hooke*, 1665. Micrographia, p. 80, pl. v, fig. x.
Cornu Ammonis, *Plancus*, 1739. Conch. Min., p. 8, pl. i, figs. I A, B, C.
Ammonia unita, &c., *Gaultieri*, 1742. Index Test., pl. xix, figs. H, I.
Cornu Ammonis, *Ginanni*, 1757. Opere postume, &c., vol. ii, Test. Adriat., &c., p. 20, pl. xiv, figs. 111 and 112.
— Hammonis, *Plancus*, 1760. Conch. Min. Notis, ed. 2, p. 8, pl. i, figs. 1 A, B, C.
Nautilus Beccarii, *Linné*, 1767. Syst. Nat., 10th edit., 1758, p. 710, No. 237; 12th edit., 1767, p. 1162, No. 275.
Cornu Hammonis legitimum, &c., *Martini*, 1768. N. Syst. Conch. Cab., p. 261, pl. xix, figs. 178, 179; pl. xx, figs. 175 A, *b*, 176 A, *b*, 177 A, *b*.
Corno d'ammone, *Targioni*, 1770. Relaz. d'Alc. Viaggi, ed. 2, vol. iv, p. 13, pl. i, figs. 17—19, 21—36 (?).
Corne d'ammon, *d'Argenville* (*Favanne* and *d'Argenville*), 1780. Conchyliologie, vol. i, p. 680, p. 731, pl. lxix, D 1.
Ammoniæ *cochleatæ globoso-rotundatæ*, *Soldani*,[1] 1780. Saggio Orittogr., p. 103, pl. ii, figs. *f*, F, G.
Nautilus Beccarii, *Schröter*, 1783. Innern Bau, &c., p. 2, pl. i, fig. 3.
Nautilus spiralis umbilicatus, &c., *Walker and Boys*, 1784. Test. Min., &c., p. 18, pl. iii, fig. 63.
Nautilus Beccarii perversus, *Walker and Boys*, 1784. Test. Min., p. 18, pl. iii, fig. 64.
— — *Murray*, 1785. Amœn. Acad., vol. viii, p. 143, pl. ii, fig. 16.
— — *Linné*, 13th (Gmelin's) edit., 1788, p. 3270, No. 4.
Hammoniæ subglobosæ, *Soldani*, 1789. Testaceographia., vol. i, pt. 1, p. 56, pl. xxxv, fig. P.
— globoso-rotundatæ, *Soldani*, 1798. Testaceographia, vol. ii, Append., p. 139, pl. ii, figs. 21*f*, F, G.
Nautilus Beccarii, *Adams* (*Kanmacher*), 1798. Essays Microsc., p. 640, pl. xiv, fig. 20.
— — *Montagu*, 1803. Test. Brit., pp. 186, 187 (*N. perversus*).
Rotalites discorbula, *Lamarck*, 1806. Ann. Mus., vol. v, p. 185, No. 4; vol. viii, pl. lxii, fig. 9.

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[1] Several of Soldani's figures can be referred to *Rotalia Beccarii*, var. *ammoniformis*, d'Orb., namely, Hammoniæ Beccarii vulgatissimæ, *Soldani*, 1780; Saggio Orittogr., p. 102, pl. ii, figs. *d*, D, E; Hammoniæ *Beccarii*, seu *vulgatissimæ*, *Soldani*, 1789; Testaceogr., vol. i, part 1, p. 55, pl. xxxiv, figs. K. L; Hammoniæ conico-tuberculatæ, *Soldani*, 1789; Testaceogr., vol. i, part 1, p. 56, pl. xxxv, fig. T; and Hammoniæ *Beccarrii*, *Soldani*, 1789; Testaceogr., vol. ii, Append., p. 139, pl. ii, figs. *d*, D, E.

NAUTILUS BECCARII et N. PERVERSUS, *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 116.
— — *Montagu*, 1808. Test. Brit., Suppl., p. 74, pl. xviii, fig. 4.
— — PERVERSUS, *Montagu*, 1808. Ibid., p. 75, pl. xviii, fig. 6.
— — *Parkinson*, 1811. Org. Rem. Former World, vol. iii, p. 108, pl. xi, figs. 27, 28.
— — et N. BECCARII PERVERSUS, *Pennant*, 1812. Brit. Zool., vol. iv, p. 247.
— — *Pulteney*, 1813. Hutchins' Dorset, ed. 2, vol. iii, p. 42, pl. xix, fig. 30.
— — *Brookes*, 1815. Introd. Conch., p. 91, pl. v, fig. 58.
DISCORBULA ARIMINENSIS, *Lamarck*, 1816. Tabl. Encycl. Méth., pl. cccclxvi, figs. 6 *a*, *b*.
STREBLUS, *Fischer*,[1] 1817. Adversaria Zoologica, fasc. ii, Mém. Soc. Imp. Nat. Moscou, vol. v, p. 449, pl. xiii, figs. 5 *a*, *b*.
NAUTILUS BECCARII, *Turton*, 1819. Conch. Dict., p. 119.
Cornu Ammonis Ariminense, *Parkinson*, 1822. Introd. Foss. Org. Rem., p. 169, pl. vi, fig. 19.
NAUTILUS BECCARII, *Brookes*, 1823. Anleit., &c., p. 80, pl. v, fig. 58.
ROTALITES DISCORBULA, *Defrance*, 1824. Dict. Sci. Nat., vol. xlvi, p. 303.
NAUTILUS BECCARII, *Wood*, 1825. Index Testac., p. 63, pl. xiii, fig. 9.
ROTALIA (TURBINULINA) TORTUOSA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 275, No. 40; Modèle, No. 74.
— — BECARII (sic), *d'Orb.*, 1826. Ibid., No. 42.
— — ITALICA (part), *d'Orb.*, 1826. Ibid., No. 43.
— CORALLINARUM, *d'Orb.*, 1826. Ibid., No. 48; Modèle, No. 75.
TURBINULINA ITALICA, *Risso*, 1826. Hist. Nat. Europ. Mérid., vol. iv, p. 18.
ROTALITES DISCORBULA, *Defrance*, 1827. Dict. Sci. Nat., vol. xlvi, p. 303.
NAUTILUS BECARII et N. PERVERSUS, *Brown*, 1827. Illustr. Recent Conch., p. 1, pl. i, figs. 11, 12; *Rotalia Beccarii*, p. 138; and 2nd edit., 1844, p. 145.
— BECCARIA [RII], *Fleming*, 1828. Brit. Anim., p. 232, No. 11.
— BECCARII-PERVERSUS, *Fleming*, 1828. Ibid., No. 12.
ROTALIA BECCARII, *Ehrenberg*, 1838. Abhandl. Ak. Berlin, vol. iv, p. 133, pl. i, figs. 1 A, *a—e*.
ROSALINA PARKINSONIANA, *d'Orb.*, 1839. Foram. Cuba, French ed., p. 99, pl. iv, figs. 25—27; Spanish ed., 1840, p. 105, pl. iv, figs. 25—27.
— CATESBYANA, *d'Orb.*, 1839. Ibid., Spanish, 1840, p. 105, pl. iv, figs. 22—24.
— BECCARII, *d'Orb.*, 1839. Ibid., Spanish, 1840, p. 105.
— INCA, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 45, pl. vii, figs. 1—3.
— CONSOBRINA, *d'Orb.*, 1839. Ibid., p. 46, pl. vii, figs. 4—6.

[1] Fischer de Waldheim gave no specific name to this shell. His explanation of the generic term *Streblus* ("στρεβλος, tortuosus") has been mistaken for a specific name. He refers it correctly to Gaultieri's "Ammonia unita" and to Linné's *Nautilus Beccarii*.

Nautilus Beccarii, *Macgillivray*, 1843. Moll. Anim. Aberd., p. 35; *Rotalia*, 1844, 2nd edit., p. 35.
Rosalina Viennensis, *d'Orb.*, 1846. For. Foss. Vien., p. 177, pl. x, figs. 22—24.
Rotalia Beccarii, *Mantell*, 1850. Pictorial Atlas, p. 143, pl. lxii, figs. 3, 27, 28.
— — *Maitland*, 1851. Descript. Syst. Anim. Belg. Septentr., p. 6.
Rosalina Amaliæ, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 254, pl. xxi, figs. 12 a—c.
— radiata, *Costa*, 1856. Ibid., p. 255, pl. xxi, figs. 13 a—c.
Rotalia Beccarii, *G. B. Sowerby*, 1856. Foram. Colne Riv., p. 1, figs. 2, 3.
Rotalina Beccarii, *Williamson*, 1858. Rec. For. Gt. Br., p. 48, pl. iv, figs. 90—92.
Rotalia Beccarii, *Mackie*, 1859. Recreat. Science, vol. ii, p. 145, fig. 7.
— — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iv, pp. 338 and 348.
— — — 1860. Ibid., vol. v, p. 294, No. 10.
— — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, Table.
— — *Carpenter*, 1862. Introd. Foram., p. 212.
Rosalina inflata, *Seguenza*, 1862. Atti Accad. Gioen., ser. 2, vol. xviii, p. 106, pl. i, fig. 6.
Rotalia Beccarii, *Parker and Jones*, 1863. Ann. Nat. Hist., 3rd ser., vol. xii, p. 216, No. 123; and p. 436, No. 54.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 82.
Rosalina Mackayi, *Karrer*, 1864. Novara-Exped. Geol. Theil, vol. i, pt. 2, p. 82, pl. xvi, fig. 14.
Rotalia Beccarii, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 388, pl. xvi, figs. 29, 30.
— — *Brady*, 1865. Nat. Hist. Trans. Northd. and Durham, vol. i, p. 105, No. 1.
Rotalina Beccarii, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manch., vol. iv, p. 206.
Rotalia Beccarii, *Sars*, 1865. Foss. Dyrelevn. Qvartærper., p. 55, &c.
— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 30, pl. iii, fig. 83; and p. 31, pl. iii, fig. 84.
— — — 1866. Monogr. For. Crag, Appendices, No. 88, pl. ii, figs. 19—21.
— — *Harting*, 1866. Magt. Klein., p. 101, fig. 40.
— — *Reuss*, 1867. Sitzungsb. k. Ak. Wiss. Wien vol. lv, p. 104.
— — *Karrer*, 1868. Ibid., vol. lviii, p. 187, No. 1.
— — — 1868. Jahrb. k. k. Geol. Reichsanstalt, Jahrg. 1868, p. 577.
— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 357; Trans. Geol. Soc. Glasgow, vol. iii, p. 127.
Rotalina Becarii (sic), *Parfitt*, 1869. Rep. Trans. Devon. Assoc., vol. iii, p. 70.
Rotalia Beccarii, *Brady*, 1870. Ann. Mag. N. H., ser. 4, vol. vi, p. 303, pl. xii, figs. 8 *a—c*.
— — *Anon.*, 1870. Sci. Gossip, p. 11, fig. 26.

ROTALIA BECCARII, *G. M. Dawson*, 1870. Canad. Nat., ser. 2, vol. v, p. 179.
— — *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanst., vol. xxi, p. 71.
— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 173, pl. xii, fig. 147.
— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
— — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 26, pl. ii, figs. 5 *a*, *b*.
— — *Morris*, 1876. Lect. Geol. Croydon, p. 8, figs. 2—4.
— — *Zittel*, 1876. Handb. Paläont., vol. i, p. 94, fig. 32^2.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 43.
— — *Siddall*, 1878. Proc. Chester Soc. Nat. Hist., part 2, p. 55.
ROSALINA MAREMII, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 27, pl. ii (vii), fig. 15.
— TROCHEATA, *Terquem*, 1878. Ibid., p. 28, pl. ii (vii), fig. 18.
ROTALIA PUNCTATO-GRANOSA, *Seguenza*, 1879. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 147, pl. xiii, fig. 37.
— BECCARII, *Carpenter*, 1879. Encyclop. Brit., edit. 9, vol. ix, p. 380, fig. 18.
— — *Nicholson*, 1879. Manual Palæont., vol. i, p. 109, fig. 18°.
— — *Terrigi*, 1880. Atti Acc. Pontif. Nuov. Lincei, vol. xxxiii, p. 208, pl. iii, fig. 62; and pl. iv, figs. 63—66.
— — var. INFLATA, *Terrigi*, 1880. Ibid., p. 210, pl. iv, fig. 67.
— — *Jones*, 1883. Microgr. Dict., edit. 4, p. 668, pl. xxiv, figs. 13, 14.
— BECCARI [RII], *Uhlig*, 1883. Jahrb. k. Geol. Reichsanst., vol. xxxiii, p. 773, pl. viii, figs. 8 *a*, *b*.
— BECCARII, *Brady*, 1884. Report 'Challenger,' pp. 627 and 704, pl. cvii, figs. 2, 3.
— BECCARI [RII], *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 421, fig. 266^{23}.
— (TURBINULINA) TORTUOSA, *Basset*, 1885. Ann. Sci. Char.-Inf., p. 162, fig. 74.
— BECCARII, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 143 and 172.
— — *Wright*, 1886. Proceed. Belfast Field-Club, Appendix ix, p. 332, pl. xxvii, fig. 15.
— — *Brady*, 1887. Journ. Roy. Micr. Soc., p. 923.
— BECCARI [RII], *Malagoli*, 1888. Boll. Soc. Geol. Ital., vol. vi, fasc. 4, p. 522, pl. xiii, fig. 11.
— BECCARII, *Chapman*, 1888. Sci. News, p. 413, fig. 17.
— — *Prestwich*, 1888. Geology, vol. ii, p. 420, figs. 210 *b*, *c*.
— — *Terrigi*, 1891. Mem. Descriz. Cart. Geol. Italia, vol. iv, part 1, p. 108.

Rotalina Beccarii, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 420, pl. xix, figs. 25—27.
Rotalia Beccarii, *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 455.
— — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., pp. 11, 12, and 19.

Characters.—Shell composed of four or five convolutions. Superior (spiral) surface more or less convex or conical; inferior, convex or flattened. All the chambers are visible on the spiral surface, the last convolution only on the lower. Septal lines usually limbate and hyaline on the spiral surface; irregularly excavated and obscured by granulation on the inferior face. Aperture single, simple, on the inner margin of the terminal chamber.

Our figure of the edge view of *Rotalia Beccarii* (Pl. II, fig. 21) is scarcely characteristic. It appears to have been drawn from a point not exactly perpendicular to the transverse axis of the shell, and in consequence the spiral side is flatter and less distinctly trochoid than is usual in good specimens. Prof. Williamson gives admirable and characteristic figures in his 'Monograph' (pl. iv, figs. 90—92); and to these, as well as to his detailed history of the species, we would refer those who desire fuller information in respect to it.

Occurrence.—*Rotalia Beccarii* is essentially a shallow-water form, of temperate and tropical seas. It is most frequently met with at depths down to 50 fathoms; but specimens were found by the 'Challenger' at depths so great as 2950, and by the 'Gazelle' at 2416 fathoms.

Fossil specimens have been recorded from the Upper Jurassic of Russia (Uhlig, 1883); the Neocomian (Bargate Beds of Surrey); the Chalk of Taplow and Ireland; the Eocene (London Clay and Thanet Sands); the Miocene of Italy, Malaga, and Vienna; the Pliocene of Italy and St. Erth; and the Pleistocene generally. We have also specimens in our own collection from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it is of very frequent occurrence, and we have specimens from every zone examined. It is also a common form in the Upper Crag, as recorded in the First Part of the Monograph.

2. Rotalia orbicularis, *d'Orbigny*, 1826. Woodcut, figs. 24 *a*, 24 *b*.

Part I, 1866, Appendices I and II, Tables, No. 89.

Pulvis testaceus ex microscopicis testis, &c., *Soldani*, 1780. Saggio Orittogr., p. 110, pl. viii, figs. *aa*, AA, BB (= *Gyroidina lævigata*, d'Orb.).

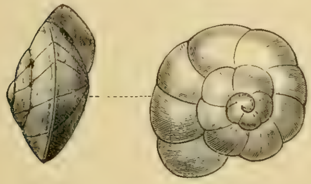
Gyroidina orbicularis, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 278, No. 1; Modèle, No. 13.
— lævigata, *d'Orb.*, 1826. Ibid., p. 278, No. 2.
Rotalia orbicularis, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 123, Tables.
— — *Reuss*, 1861. Sitzungsb. Akad. Wiss. Wien, vol. xlii, p. 359.
— — — 1863. Bullet. Acad. Roy. Belg., ser. 2, vol. xv, p. 155, No. 54.
— — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 16.
— — *J. and P.*, 1864. Geologist, vol. vii, p. 86.
— Beccarii, var. orbicularis, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 389, pl. xvi, fig. 34.
— orbicularis, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 20, pl. iii, fig. 85.
— — *J., P., and B.*, 1866. Mon. Crag Foram., Append., No. 89.
— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 358; Trans. Geol. Soc. Glasgow, vol. iii, p. 125.
— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 175, pl. xii, fig. 150.
— — *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. III, p. 60, pl. xii, figs. 1—3.
— — *Brady*, 1884. Report 'Challenger,' pp. 627, 706, pl. cvii, fig. 5 ?; pl. cxv, fig. 6.
— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 153.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 923.
— — *Terrigi*, 1891. Mem. Descriz. Cart. Geol. (R. Com. Geol. Ital.), vol. iv, p. 108, pl. iv, fig. 14.
Rotalina orbicularis, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 421, pl. xix, figs. 22—24.
Rotalia orbicularis, *Fornasini*, 1894. Foram. Coll. Sold., Sagg. Oritt., p. 9.
Rotalina orbicularis, *Egger*, 1895. Jahresb. Nat. Ver. Passau, vol. xiv, p. 34, pl. v, figs. 11 *a—c*.

Characters.—Shell composed of three or four convolutions; spiral face flat or slightly conical, inferior surface highly convex. All the segments are visible on the spiral surface, those of the latest convolution only on the other face. Septal lines scarcely depressed. Aperture on the inner margin of the terminal chamber, close to its line of contact with the previous whorl.

This minute compact form differs from its type *Rotalia Beccarii* in having its spiral face nearly flat, and its inferior surface much more highly convex. It is also free from granular or other exostoses indicative of free growth of shell-substances.

Occurrence.—*Rotalia orbicularis* appears to be a moderately deep-water form. The depths recorded for the species in the 'Challenger' Report range from 100 to 2400 fathoms, and the 'Gazelle' records extend from 194 to 2991 fathoms. Most of the specimens were taken from moderate depths. The geographical range is extensive, but apparently does not extend to the Arctic or Antarctic regions.

It has been recorded as a fossil from the Eocene (London Clay and Calcaire Grossier); from the Miocene of Italy and Malaga; from the Pliocene of Italy and Antwerp, and the Pleistocene of Norway and Scotland (Kintyre). In the Coralline Crag we have found it sparingly in nearly every zone examined.



FIGS. 24 *a*, 24 *b*.—*Rotalia orbicularis*, d'Orbigny. From the 'Trans. Linn. Soc.,' vol. xxiv, pl. xlviii, figs. 16 *a*, *b*. × 100 diam.

FIG. 24 *b*. FIG. 24 *a*.

3. ROTALIA CALCAR (*d'Orbigny*), 1826. Plate II, figs. 16—18 (*Calcarina rarispina*).

Part I, 1866, Appendices I and II (*Calcarina rarispina*), Tables, No. 90.

CALCARINA CALCAR, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 276, No. 1; Modèle, No. 34.
ROTALIA ARMATA, *d'Orb.*, 1826. Ibid., p. 273, No. 22; Modèle, No. 70.
CALCARINA RARISPINA, *Deshayes*, 1833. In Lyell's Principles of Geology, vol. iii, p. 251, pl. iv, figs. 9—11.
— CALCAR, *d'Orb.*, 1839. Foram. Cuba, p. 93, pl. v, figs. 22—24.
— RARISPINA, *Brown*, 1843. Elem. Foss. Conch., p. 25, pl. ii, figs. 45, 46.
ROTALIA (CALCARINA) RARISPINA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 124, Tables.
CALCARINA CALCAR, *Carpenter*, 1862. Introd. Foram., p. 223, pl. xiii, fig. 21.
— SPENGLERI, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 24, pl. iii, fig. 87.
— ARMATA, *Parker, Jones, and Brady*, 1865. Ibid., p. 30, pl. iii, fig. 88.
— RARISPINA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices, No. 90, pl. ii, figs. 16—18.
ROTALINA ARMATA, *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. III, p. 67, pl. v (xiii), figs. 14, 15.

ROTALIA CALCAR, *Brady*, 1884. Report 'Challenger,' pp. 627, 709, pl. cviii, figs. 3 and 4 (?).
ROTALINA CALCAR, *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 423, pl. xix, figs. 1—3.

Characters.—Shell biconvex, with a marginal armature arising from the angular or pointed peripheral ends of the chambers, the shell having a pointed or zigzag outline according to the size and shape of the projecting angles.

Occurrence.—*Rotalia calcar* appears to be a shallow-water form, and to be most at home in tropical waters. The 'Challenger' apparently gathered no specimen, but Brady mentions in his Report that the species "is not uncommon in the shallow-water coral-sands of the East and West Indies; it occurs also in the Mediterranean and the Red Sea; on the shores of Madagascar, the Mauritius, and Ceylon; and at the Cape of Good Hope." The 'Gazelle' obtained specimens, but few in number, from the Mauritius and off the south-west of Australia.

The records of the species in a fossil condition extend to the Eocene (Calcaire Grossier—Terquem); it has also been obtained from the Barton Beds (Brady); from the Miocene of Malta (Brady) and Muddy Creek (Howchin); from the Casterlian and Scaldisian of Antwerp (Burrows and Holland); and from St. Erth (Millett). In the Coralline Crag it is not uncommon, and we have specimens from every zone examined. A few minute specimens have also been met with in the Red Crag of Essex, as recorded in the First Part of this Monograph.

Sub-family 3.—TINOPORINÆ.

Brady, 'Challenger' Report, p. 74.

Chambers irregularly heaped; with or without a spiral primordial portion. Usually without any general aperture.

Genus 1.—GYPSINA, *Carter*, 1877.

Brady, Report 'Challenger,' 1884, *pp.* 74 *and* 716.

CERIOPORA, *Reuss.*
ACERVULINA, *Schultze*, *Marsson.*
ORBITOLINA,[1] *Parker and Jones.*

[1] The little, globular and hemispherical, bead-like fossils from the Chalk, formerly also referred to *Orbitolina* by Parker and Jones ('Ann. Mag. Nat. Hist.,' ser. 3, vol. vi, 1860, p. 37), and by others previously to *Millepora*, *Tragos*, and *Coscinopora*, have been placed, as being allied to *Hydractinia*, in a new genus, *Porosphæra*, by Steinmann. Von Zittel also refers it to the *Hydrozoa;* but Nicholson thinks it may be a sponge.

TINOPORUS, *Carpenter, Parker and Jones, Brady, Robertson, Wright, Carter, Karrer, Siddall, Terrigi.*
POLYTREMA, *Brady, Carter.*
CELLEPORA, *Parfitt.*
GYPSINA, *Carter, Brady.*

General Characters.—Free or adherent; spherical, subconical, or compressed. Chambers numerous, minute, crowded; rounded, polygonal, or irregular in shape; surface of chambers porous; septa prominent, forming the areolated surface of the shell.

1. GYPSINA VESICULARIS (*Parker and Jones*), 1860. Woodcut, fig. 25.

Part I, 1866 (*Tinoporus lævis*), Appendix I, Table, No. 91; Appendix II, Table, No. 94.

ORBITOLINA VESICULARIS, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. vi, p. 31, No. 5.
— — var. CONGESTA, *P. and J.*, 1860. Ibid., p. 32, No. 6.
— LÆVIS, *Parker and Jones*, 1860. Ibid., p. 33, No. 7.
TINOPORUS LÆVIS, *Carpenter*, 1860. Phil. Trans., p. 559, pl. xxi, figs. 1—3. [Large subconical specimen from the tropics.]
— VESICULARIS, *Carpenter*, 1862. Introd. Foram., p. 224, pl. xv, figs. 1—4.
— LÆVIS, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 470, pl. xlviii, fig. 17. [Small subspheroidal specimen from Shetland.]
— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Appendices, Nos. 91 and 94.
— — *Brady*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 304.
GYPSINA VESICULARIS, *Carter*, 1877. Ibid., ser. 4, vol. xx, p. 173.
TINOPORUS VESICULARIS, *Goës*, 1882. K. Svensk. Vet. Ak. Handl., vol. xix, No. 4, p. 104, pl. vii, figs. 245—247. [A lenticular variety; possibly a compressed *T. globulus.*]
GYPSINA VESICULARIS, *Brady*, 1884. Report 'Challenger,' p. 718, pl. ci, figs. 9—12.
— — — 1887. Journ. R. Micr. Soc., p. 923.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 382, pl. xiv, figs. 20—23.
— — var. INTERMEDIA, *Goës*, 1894. Kongl. Svensk. Vet. Akad. Handl., vol. xxv, No. 9, p. 92, pl. xv, figs. 788 *a, b, c.* [Between *globulus* (Reuss) and *G. vesicularis* (P. and J.).]
— — var. DISCUS, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, No. 1, p. 74, pl. vi, figs. 4—6. [Flat form.]

Characters.—Shell free (or parasitic ?), subspherical, or shaped like a truncate cone. Chambers very numerous, nearly equal in size; arrangement mostly confused. Surface marked by an angular areolation, due to the external prominence of the limbate septa.

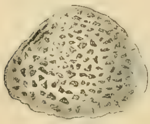


FIG. 25.

Gypsina vesicularis (Parker and Jones). From Brady's Report 'Challenger,' &c., pl. cii, fig. 10. × 15 diam.

Occurrence.—Brady states in the 'Challenger' Report that the geographical and geological distribution of this species is co-extensive with that of *Gypsina globulus* (Reuss); "they occur together in the coral sands of warm latitudes, at depths ranging from the littoral zone to about 400 fathoms. Small examples are occasionally met with on the northern and western shores of the British Islands."

Fossil specimens have been recorded from the Miocene of Austria-Hungary, Malta, and Jamaica, from the Pliocene of Costa Rica, and from Tertiary beds of Palermo, Bordeaux, and San Domingo.

Gypsina vesicularis is rare in the Crag. One specimen was found in the Polyzoan Crag of Sudbourne.

Family 6.—NUMMULINIDÆ, *Brady.*

'Challenger' Report, 1884, *p.* 74.

Symmetrically spiral, possessing a supplemental skeleton and a canal-system.

Sub-family 1.—POLYSTOMELLINÆ, *Brady.*

'Challenger' Report, 1884, *p.* 75.

Bilaterally symmetrical, nautiloid. Lower forms without supplemental skeleton or interseptal canals; higher types with canals opening along the external septal depressions.

Genus 1.—Nonionina, *d'Orbigny*, 1826.

Carpenter's Introd. Foram., 1862, *p.* 286; *Brady*, '*Challenger*' *Report*, *p.* 724.

Synonyms:

Nautilus, *Linné, Gmelin, Adams, Walker and Jacob, Soldani, Fichtel and Moll, Montagu, Maton and Rackett, Pennant, Turton, Wood, Fleming, Dillwyn, Brown.*
Nautilites, *Soldani.*
Chrysolus, Florilus, and Nonion, *de Montfort.*
Melonis, *de Montfort, Blainville.*
Pulvinulus, *Lamarck.*
Placentula, *Lamarck, Defrance.*
Cristellaria, *Lamarck.*
Lenticulina, *Defrance, Blainville.*
Polystomella, *Defrance, Blainville, Macgillivray, Thorpe, Parker and Jones.*
Robulina, *d'Orbigny.*
Aristerospira, *Ehrenberg.*
Nonionina, *d'Orbigny, Sander Rang, Menke, Römer, Bronn, Reuss, Czjzek, Alth, Risso, Williamson, Ehrenberg, Costa, Parker and Jones, Egger, Karrer, von Gümbel, Carpenter, Seguenza, Brady, M. Sars, Alcock, Dawson, Millett, Parfitt, Woodward and Thomas, Terrigi, Fornasini, von Hantken, Terquem, Goës, Schwager, Andreae, Balkwill and Wright, A. Silvestri, and others.*

General Characters.—Shell free; spiral, equilateral. Inner convolutions nearly or entirely concealed by the outermost whorl. Septa, in well-developed forms, thickened at and near the umbilicus by a granulate or stellate deposit of exogenous shell-substance. Aperture single, curved, slit (normally simple), on the inner edge of the terminal chamber.

Supplemental skeleton either absent or rudimentary, and confined to the umbilical region. No external septal pores nor bridges, except in some transitional individuals.

Mr. F. W. Millett has kindly supplied the following systematic list or scheme of the *Nonioninæ*, arranged gradationally, and based chiefly upon the condition of the umbilical region (pp. 339—341). It shows how the tendency to exogenous growth increases with the inflation of the chambers, and the consequent lobulation of the periphery characteristic of one of the types, *N. depressula*. The scheme is of course defective, as it refers only to *published figures*. It might be greatly improved by a careful examination of specimens in good collections.

The affinities of the species of the Foraminifera are so complex that it is

impossible to indicate them in their proper order on a plane surface, such as that of a sheet of paper. Varieties radiate in all directions from the type forms; and to properly indicate their relationship we should have to take a series of spiked balls, like that with which the giant in the Guildhall is armed, and attach the different varieties to these spikes at varying distances from the ball. Consequently, in this table such characters as periphery, rounded or angular—chambers, few or many, straight or arched—have not received the consideration due to their importance.

The side lines in the table do not indicate exactly where one type ends and another begins; one might as well try to separate the colours of the rainbow by definite lines. As a rule Mr. Millett has commenced with *thin* forms, gradually working up to the *thicker*; thus, from the thin *communis* to the thick *Labradorica*, from the thin *umbilicatula* to the thick *pompilioides*, and so on.

The particulars given in this list will be sufficient for anyone who has C. D. Sherborn's 'Index to the Genera and Species of the Foraminifera,' except of course for the figures published after a certain date (1888). Figures which are merely copies are not referred to.

The *Nonionina leo* of Karrer, 1868, is not included, as it might be an *Operculina*. Nor are the very doubtful forms given by Zwingli and Kübler referred to, and very sparing use has been made of Ehrenberg's figures of translucent specimens.

Mr. Millett observes that the *Polystomellæ* might also be treated in a similar manner; but he has not found any figure of those in which the two conditions of the umbilical region are combined in one shell, as in the Gomer specimens and in *N. asterizans*.

Mr. Millett is inclined to think that the *Anomalina punctulata*, d'Orbigny ('Ann. Sci. Nat.,' vol. vii, 1826, p. 282, pl. xv, figs. 1—3), is the "unsymmetrical" form of *N. incrassata* (F. and M.). Before the Gomer specimens threw a light on the subject, most of the unsymmetrical *Nonioninæ* were assigned to *Anomalina* or *Truncatulina*;[1] and doubtless if the original specimens were now examined, many species would have to be removed from one genus to the other.

[1] See, for instance, 'Ann. Mag. Nat. Hist., ser. 3, vol. iv, 1859, p. 329, where Walker and Jacob's fig. 69 is referred to *Truncatulina* because "the two faces are decidedly unsymmetrical."

Mr. Millett's Systematic Grouping of the published figures of the Genus Nonionina.

			Umbilical region exposed on both faces.	*Umbilical region on both faces covered by exogenous or other shell-deposit.*[1]
Shell elongate.	Shell elongate by the rapid increase in width of the chambers.	Type: *communis.*	*Nonionina Sloanii*, d'Orb., 1839. Woodcut, fig. 26, p. 341.	
			— *Grateloupi*, d'Orb., 1839.	
			— *communis*, d'Orb., 1846.	
			— — Terquem, 1882.	
			— — — 1875.	
			— — Egger, 1893.	
			— *exponens*, B., P., and J., 1888.	
			— *Brownii*, d'Orb., 1839.	
			— *communis*, Terrigi, 1880.	*Nonionina scapha*, B., P., and J., 1888 (pl. xliii, figs. 20 *b*, *c*).
			— *crassula*, var. *scapha*, Goës, 1882.	
			— *scapha*, Egger, 1893.	
			— *communis*, Terrigi, 1883.	
			— *punctulata*, d'Orb., 1839.	
			— *asterizans*, var. *turgida*,[2] Williamson, 1858.	
	Shell elongate by the later chambers receding from the umbilical axis of the shell.	Type: *scapha.*	*Polystomella crispa*, var. *Nonionina turgida*, P. and J., 1865.	
			Rotalia cristellarioides, Reuss, 1863.	
			Nonionina turgida, Goës, 1882.	
			— — Brady, 1884.	
			— — Terquem, 1886.	
			— — Egger, 1893.	
			Nautilus faba,[3] F. and M., 1803.	
			— *scapha*, F. and M., 1803. Woodcut, fig. 27, p. 341.	
			Nonionina scapha, Brady, 1865.	
			— — Terrigi, 1883.	*Nonionina communis*, Terrigi, 1883.
			— *Labradorica*, Dawson, 1860.	— — Egger, 1857 (pl. xiv, figs. 11, 12).
			— — Jones, Parker, and Brady, 1866.	
			Polystomella crispa, var. *Nonionina scapha*, P. and J., 1865.	— *pauperata*, Halkyard, 1889.
			Nonionina pauper, Egger, 1857.	— *nautiloidea*, Costa, 1856 (pl. xx, fig. 1).
			— *faba*, Terrigi, 1883.	
			— *latescens*, Schwager, 1883.	— — Costa, 1856 (pl. xxii, fig. 20).
			— *Boueana*, Reuss, 1863.	— *pauperata*, Balkwill and Wright, 1885).

Shell circular.

Having the two characters combined, one umbilicus being open and the other covered up.

Nonionina Boueana, var. *Janiformis* (see p. 343).
Nautilus spiralis-umbilicatus, &c., Walker and Jacob, 1784, 'Ann. Mag. Nat. Hist.,' ser. 3, vol. iv, 1859, p. 339, H *a*.

[1] Such as the asterigerine flaps over the sutures of *Nonionina stelligera*, and even supplementary chambers if they be found to exist in any of the *Nonioninæ*.

[2] *N. turgida* is one of the most characteristic, but not the central type of the *N. communis* group.

[3] *N. faba* may be a *Polystomella*, but it has the elongate contour of *N. scapha*, and no published *Polystomella* possesses this form. It is noted in the 'Ann. Mag. Nat. Hist.,' ser. 3, vol. v, 1860, p. 103, that "this may be an oblong form" of *P. striatopunctata*.

TABLE—*continued.*

		Umbilicus open.	*Umbilicus covered.*
	Type: *Boueana.*	*Nonionina umbilicata*, Terquem, 1882.	
		— *Boueana*, d'Orb., 1846.	*Nonionina Boueana*, Brady, 1884.
		? *Anomalina insecta*, Schwager, 1883.	— — var. *armata*, Brady, 1884.
		Nonionina, cf. *Boueana*, Schwager, 1883.	
		— *Boueana*, Goës, 1894.	— — Terrigi, 1889.
		— — Egger, 1893.	
Shell circular.		— *asterizans*, Terrigi, 1880.	
		— *umbilicatula*, B., P., and J., 1888.	
		— *affinis*, Reuss, 1851.	
		— *Barleeana*, Williamson, 1858.	*Nonionina*, No. 342, v. Schlicht, 1870.
		— — Terquem, 1876.	
		— *polystoma*, Costa,[1] 1856.	*Nonionina tuberculata*, d'Orb., 1846.
		Aristerospira borealis, Ehrenberg, 1874.	— — Terrigi, 1883.
		Polystomella crispa, var. *Nonionina umbilicatula*, P. and J., 1865.	— *umbilicatula*, Egger, 1893.
	Type: *umbilicatula.*		— *Soldanii*, Egger, 1895 (fig. 18 .
		Nonionina umbilicatula, Goës, 1894.	— *asterizans*, Brady, 1884.
		— *simplex*, Karrer, 1864.	*Florilus stellatus*, Montfort, 1808.
		— *crassula*, Terquem, 1875.	*Nonionina orbicularis*, Brady, 1881.
		— *rudis*, Costa, 1856.	— — — 1884.
		— *formosa*, Seguenza, 1879.	— *depressula*, var. *orbicularis*, Madsen, 1895.
		— *astræa*, Ehrenberg, 1854.	
		— *umbilicatula*, Brady, 1884.	
		[Not named], Macdonald, 1857.	
		Nonionina umbilicatula, Terrigi, 1883.	
		— *Soldani*, Costa, 1856.	
		— *umbilicatula*, Silvestri, 1893.	
		— *Soldanii*, d'Orb., 1846.	
		Nautilus pompilioides, F. and M., 1803.	
		— *melo*, Soldani, Test., 1798 (*Nonionina melo*, d'Orb., 1826).	
		Nonionina umbilicata, d'Orb., Modèle 86, 1826.	
		Nautilus, Soldani, 1780 (p. 100, pl. ii, fig. 16, TT, VV, XX, &c.).	
		Nonionina attenuata, Costa, 1856.	
Shell circular.		— *pompilioides*, Terrigi, 1883.	
		— *umbilicata*, d'Orb., 1826.	
		— *pompilioides*, Egger, 1893.	
		— *Soldanii*, Egger, 1895 (fig. 16).	
		Melonis Etruscus, Montfort, 1808.	
		Nonionina pompilioides, Brady, 1884.	

Having the two characters combined.

Nautilus asterizans, Fichtel and Moll, 1803.

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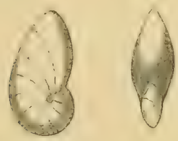
[1] Costa gives some figures showing unsymmetrical *Nonioninæ;* but where these occur, his references in the letterpress are usually either erroneous or altogether wanting.

TABLE—*continued.*

	Umbilicus open.	*Umbilicus covered.*
SHELL CIRCULAR. Type: *depressula.*	*Nonionina scapha* [thick *depressula*], J., P., and B., 1866.	*Nautilus spiralis*, &c., W. and J., pl. iii, figs. 68 and 70, 1784.
	— *umbilicata*, Jones, 1895.	*Nonionina punctulata*, Costa, 1856.
	— *punctata*, d'Orb., 1846.	— *crassula*, Williamson, 1856.
	— *perforata*, d'Orb., 1846.	— *stelligera*, d'Orb. ("Canaries"), 1839.
	— — Terrigi, 1883.	— — Brady, 1864.
	— *depressula*, Terrigi, 1889.	— — — 1884.
	— — Terquem, 1876.	— — Egger, 1893.
	— — B., P., and J., 1888.	*Polystomella crispa*, var. *Nonionina stelligera*, P. and J., 1865.
	— *Buxovillana*, Andreae, 1884.	— — var. *Nonionina asterizans*, P. and J., 1865.
	— *depressula*, Goës, 1894.	*Nonionina stelligera*, Goës, 1894.
	— *Jaccardi*,[1] Loriol, 1865.	— *stellata*, Terquem, 1882.
		— *asterizans*, Egger, 1893.
		— *granifera*, Terquem, 1882.
		— *granosa*, d'Orb., 1846.
		— — Terquem, 1882.
		— — Terrigi, 1883.
		Polystomella crispa, var. *Nonionina depressula*, P. and J., 1865.
		Nonionina depressula, Brady, 1884.
		— — Terrigi, 1880.
		Pulvinulina nonioninoides, Andreae, 1884.
		Nonionina subgranosa, Egger, 1857.
		— *depressula*, Egger, 1893.
		Nonion incrassatus, Montfort, 1808.
		Nautilus incrassatus, F. and M., 1803.
		Nonionina lævis, d'Orb., Modèle 46, 1826.
		— — Terquem, pl. x, figs. 12, 13, 1882.
		— *incrassata*, Terrigi, 1883.
		Nautilus umbilicatulus, Montagu, 1808.
		Nonionina umbilicata, Terquem and Berthelin, 1875.
		— *nodulosa*, Terquem, 1886.
		— ? *Villersensis*,[2] Loriol and Jaccard, 1865.



a b

FIGS. 26 *a*, 26 *b*. *Nonionina Sloanii*, d'Orb. From the 'Foram. Cuba,' pl. vi, figs. 18, 18 *bis*. Highly magnified.

a b

FIGS. 27 *a*, 27 *b*. *Nonionina scapha*, Fichtel and Moll. From the 'Testac. Microsc.,' pl. xix, figs. *d*, *e*. Very highly magnified.

[1] Together with *N. Villersensis* from the Purbeckian strata at Villers-le-Lac, Doubs, France.

[2] Smaller and thinner than *N. Jaccardi*.

1. NONIONINA SCAPHA (*Fichtel and Moll*), 1803; var. LABRADORICA, *Dawson*, 1860. Plate II, figs. 44, 45 (*N. Labradonica*). Woodcuts, figs. 27 *a*, *b*, p. 341.

Part I, 1866, Appendix I, Table, No. 98 (part); Appendix II, Table, No. 99 (part); *N. scapha*.

Synonyms of N. SCAPHA *and* var. LABRADORICA:

NAUTILUS SCAPHA, *Fichtel and Moll*, 1803. Test. Micr., p. 105, pl. xix, figs. *d—f*.
NONIONINA SLOANII, *d'Orbigny*, 1839. Foram. Cuba, p. 68, pl. vi, fig. 18.
— COMMUNIS, *P. and J.*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 287, pl. xi, figs. 7, 8.
— LABRADORICA, *J. W. Dawson*, 1860. Canad. Nat., vol. v, pp. 191, 192, fig. 4 (thick *N. scapha*).
— — *Parker and Jones*, 1860. A. M. N. H., ser. 3, vol. v, p. 102, No. 4.
— BOUEANA, *Reuss*, 1863. Bull. Acad. Roy. Belg., ser. 2, vol. xv, p. 156, pl. iii, figs. 47, 48.
POLYSTOMELLA CRISPA, var. (NONIONINA) SCAPHA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 404, pl. xiv, figs. 37, 38; pl. xvii, figs. 55, 56.
NONIONINA SCAPHA, *Brady*, 1865. Nat. Hist. Trans. Northd. Durham, vol. i, p. 106, pl. xii, figs. 10 *a*, *b*.
— LABRADORICA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices I and II, Nos. 98 and 99, pl. ii, figs. 44, 45 (thick variety of *N. scapha*).
— SCAPHA, var. LABRADORICA, *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, p. 416, fig. 34; and 1872, ibid., vol. vi, p. 255, pl. iii, fig. 4; and Handbook Zool., 1886, p. 46, fig. 38.
— — — *G. M. Dawson*, 1870. Ibid., n. s., vol. v, p. 177, fig. 5; Amer. Journ. Sci., ser. 3, vol. i, 1871, p. 207, fig. 5; Ann. Mag. Nat. Hist., ser. 4, vol. vii, 1871, p. 86, fig. 5.
PULLENIA COMMUNIS [ELONGATA on the plate], *Hantken*, 1875. Mitth. Jahrb. k. Ung. Geol. Anst., vol. iv, p. 59, pl. x, fig. 10.
NONIONINA SCAPHA, *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 202, pl. iv, fig. 47 (thick variety).
— FABA, *Idem*, 1883. Ibid., p. 204, pl. ix, fig. 50.
— SCAPHA, *Brady*, 1884. Rep. 'Challenger,' p. 730, pl. cix, figs. 14, 15, and 16?.
— — *Idem*, 1887. Journ. R. Micr. Soc., p. 925.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, p. 230, pl. xliii, fig. 20.

NONIONINA SCAPHA, *Terrigi*, 1889. Mem. R. Accad. Lincei, ser, 4 vol. vi, p. 120 pl. x, fig. 7.
— — *Idem*, 1891. Mem. Descriz. Carta Geol., R. Com. Geol. Ital., vol. iv, p. 110, pl. iv, fig. 18.
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 424, pl. xix, figs. 42, 43 (elongate).
— COMMUNIS, *Idem*, 1893. Ibid., figs. 40, 41.
— SCAPHA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 104, pl. xvii, fig. 830.
— — *Woodward and Thomas*, 1895. Final Report Geol. Nat. Hist. Survey Minnesota, vol. iii, pt. 1, pp. 48—52, pl. E, figs. 35, 36.
— COMMUNIS, *Egger*, 1895. Jahresb. xvi, Naturh. Vereins Passau, p. 40, pl. iii, fig. 17.
— SCAPHA, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 79.

Characters.—Shell oblong-ovate, depressed at the umbilicus; margin obtuse, rounded; chambers numerous arcuate, more or less ventricose; aperture crescentic on the inner margin of the terminal chamber.

By the larger growth of the later chambers, the septal face of the last segment varies from oval to more or less cordate, as in the thick variety named *N. Labradorica* by Dawson.

Occurrence.—*Nonionina scapha* is widely diffused. It is frequent in dredgings from 30 to 100 fathoms, and has been taken at various depths down to 1421 fathoms. Taking the records of the 'Challenger' and the 'Gazelle' together, it has been found in nearly every sea.

Its geological range extends to the Neocomian (Bargate Beds) of Surrey, but we are aware of no record in subsequent deposits until the Middle Tertiary is reached. Specimens have been obtained from the Miocene of Italy, Malaga, and Vienna; from the Pliocene of Italy, Antwerp, and St. Erth; and from several Pleistocene deposits. In the Coralline Crag it occurs in every zone examined, and it was recorded in the First Part of the Monograph as rare from the Red Crag.

2. NONIONINA BOUEANA, *d'Orbigny*, 1846; var. JANIFORMIS, nov. J. Woodcuts figs. 28 *a*, *b*, *c*.

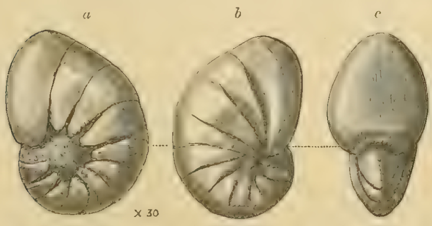
Synonyms of the typical form:

NONIONINA BOUEANA, *d'Orb.*, 1846. Foram. Foss. Vien., p. 108, pl. v, figs. 11, 12.
— — *Pictet*, 1857. Traité Paléont., 2nd edit., vol. iv, p. 498, pl. cix, fig. 17.

NONIONINA BOUEANA, *Brady*, 1884.	'Challenger' Rep., p. 729, pl. cix, figs. 12, 13.
— — *Terrigi*, 1889.	Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 119, pl. x, fig. 5.
— — *Egger*, 1893.	Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 426, pl. xix, figs. 34, 35.
— — *Goës*, 1894.	K. Svensk. Vet.-Akad. Handl., vol. xix, p. 104, pl. xvii, figs. 829 *a*, *b*.

Characters.—The varietal form under notice has a nearly circular outline and subacute peripheral edge; it is stoutly made, and the chambers, which are numerous, narrow, falciform, and slightly inflated, increase rather rapidly in size towards the end. Some specimens are rather more oval than others. One umbilicus is exposed, and on this side the sutures are visible from the periphery to the umbilicus, but the other umbilicus is covered with granular shell-substance. Thus the variety under notice has at once the two characters that divide the *Nonioninæ* into two series. Hence it may be called *Janiformis*.

N. asterizans in Fichtel and Moll's figures has the two sides differing in a similar manner; but this new variety is the most pronounced of the unsym-



FIGS. 28 *a*, 28 *b*, 28 *c*. *Nonionina Boueana*, d'Orb., var. *Janiformis*, nov. Specimen from the Coralline Crag, Gomer (zone **g** ?). × 30 diameters. 26 *a*, the closed side; 26 *b*, the open side; 26 *c*, the apertural face.

metrical forms of the genus that Mr. Millett has been able to observe. He regards it as more developed in this direction than *N. asterizans*. In its contours it agrees more closely with *N. Boueana*.

Occurrence.—Numerous specimens in good condition were found by Mr. Millet in the Coralline Crag at Gomer, or Gomer Field (now ploughed over), between the Ferry on the River Butley and Gedgrave, Suffolk.

In the recent state *Nonionina Boueana* lives in comparatively shallow water in the Atlantic and the Red Sea; also near Amboyna, Hong Kong, and the west coast of Patagonia. It is found in the Oligocene of Germany, and the Miocene of Austria and South Italy.

3. NONIONINA UMBILICATULA (*Montagu*), 1808; Var. passing into *N. depressula*. Plate V, fig. 32 (*N. umbilicatula*). Woodcuts, figs. 29 *a*, *b* (the zoological type).

Nautilitæ...... minusculæ, &c., *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 66, pl. lx, fig. B.

Lenticulæ minusculæ, *Soldani*, 1798. Testaceogr., vol. ii, p. 110, pl. xxvi, fig. O.

NAUTILUS UMBILICATULUS, *Montagu*, 1803. Test. Brit., p. 191; Supplem., p. 78, pl. xviii, fig. 1.

NONIONINA UMBILICATA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 293, No. 5.

ROBULINA PLANCIANA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 290, No. 20.

NONIONINA SOLDANII, *d'Orb.*, 1846. For. Foss. Vien., p. 109, pl. v, figs. 15, 16.

— — *Costa*, 1856. Atti Accad. Pontan., vol. vii, p. 201, pl. xvii, fig. 11.

— POLYSTOMA, *Costa*, 1856. Ibid., p. 206, pl. xiv, fig. 10.

— BARLEEANA, *Williamson*, 1858. Rec. For. Brit., p. 32, pl. iii, figs. 68, 69.

— ASTERIZANS (*F. and M.*), var. UMBILICATULA (*Montagu*), *P. and J.*, 1859, Ann. Mag. Nat. Hist., ser. 3, vol. iv, p. 347.

POLYSTOMELLA CRISPA, var. (NONIONINA) UMBILICATULA, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 405, pl. xiv, figs. 42 *a*, *b*; pl. xvii, figs. 58, 59.

NONIONINA UMBILICATULA, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 242, pl. xii, fig. 157.

— — *Parker and Jones*, 1872. Ann. Mag. Nat. Hist., ser. 4, vol. ix, p. 218 (Macdonald's pl. v, figs. 18, 19, ibid., 1857).

— — *Brady and Robertson*, 1875. Brit. Assoc. Report for 1874, p. 191.

— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 56.

— FORMOSA, *Seguenza*, 1879. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 63, pl. vii, fig. 6.

— UMBILICATULA, *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 203, pl. iv, fig. 48.

— — *Brady*, 1884. 'Challenger' Report, p. 726, pl. cix, figs. 8, 9.

— — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 239.

— — *Brady*, 1887. Journ. R. Micr. Soc., p. 924.

— — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, p. 230, pl. xliii, fig. 19.

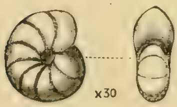
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 458.

— — *A. Silvestri*, 1893. Atti Acc. Zelant. Acireale, vol. v, p. 20, pl. iii, figs. 26, 27.

NONIONINA UMBILICATULA, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 426, pl. xix, figs. 36, 37.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 103, pl. xvii, fig. 823 (fig. 824, *Haplophragium ?*).
— — *De Amicis*, 1895. Nat. Sicil., Ann., xiv, pp. 55 and 63.
— SOLDANII, *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 40, pl. iii, figs. 18 *a*, *b*.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 78.

For a more exact, and not chronological, list of the near allies of *N. umbilicatula* see Mr. Millett's catalogue, p. 340.

Characters.—Small, neat, many-chambered, and nautiloid; compact with flush septa and hollow umbilici.



FIGS. 29 *a*, 29 *b*.—*Nonionina umbilicatula* (Montagu).[1] Zoological type. Specimen from the Coralline Crag of Broom Hill; zone **e**. × 30 diam.

Occurrence.—*Nonionina umbilicatula* is a cosmopolitan form, and has a bathymetrical range down to 3125 fathoms. It has been found in a fossil condition in the Eocene (London Clay and Calcaire Grossier); in the Oligocene of Germany; the Miocene of Italy, Vienna, and Muddy Creek, Victoria; the Pliocene of Italy, Antwerp, Garrucha (Spain), and St. Erth; and in the Pleistocene generally. In the Coralline Crag we have specimens from Sudbourne and Broom Hill, zone **d**.

The variety shown by Pl. V, fig. 32, began its growth like *N. umbilicatula*, with neatly compact chambers; but afterwards had inflated chambers with sunken sutures. This varietal condition is illustrated by several published figures, such as (*N. crassula*) by Parker and Jones, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. xix, 1857, p. 286, pl. xi, figs. 5, 6; by Williamson (*N. crassula*), 'Rec. Brit. Foram.,' 1858, pp. 23 (*umbilicatula*, p. 97), pl. iii, figs. 70, 71; by Goës as *N. depressula*, 'K. Svensk. Vet. Selsk. Handb.,' vol. xxv, p. 104, pl. xvii, figs. 825, 826. See also *N. depressula*, Brady, 'Challenger' Rep., p. 725, pl. cix, figs. 6, 7.

According to the view as to whether the earlier or the later stage is to be regarded as characteristic, this form may be either *umbilicatula* becoming *depressula*, or *depressula* beginning as *umbilicatula*. In either case the later stage may be said to be affected by decadence or weakness of growth, resulting in a variation from the compactly built type.

The specimen under notice is one of several rather variable individuals

[1] The specimen figured by Montagu, although the first *published* form, is not so good a real *zoological type* of the "species" as the form here represented. Such specimens as this have been carefully figured by d'Orbigny as *N. Soldanii*, and by Brady and others as *N. umbilicatula*.

(fig. 32), and was probably from the Coralline Crag of Sutton (?). It is in Mr. F. Chapman's Collection.

4. NONIONINA DEPRESSULA (*Walker and Jacob*), 1798. Plate II, figs. 36, 37; Thick Variety.

Part I, Appendix I, No. 98 (*N. scapha*); II, No. 99 (*N. scapha*).

Synonyms of the Type:

Nautilus spiralis utrinque subumbilicatus, geniculis depressis plurimis, *Walker and Jacob*, 1784. Test. Min., p. 19, pl. iii, fig. 68.
NAUTILUS DEPRESSULUS, *Walker and Jacob*, 1798. Adams's Essays, Kanmacher's edition, p. 641, pl. xiv, fig. 33.
NONIONINA DEPRESSULA, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iv, pp. 339 and 341.
— ASTERIZANS, var. DEPRESSULA, *P. and J.*, 1862. Carpenter's Introd. Foram., Appendix, p. 310.
— SCAPHA, *J., P., and B.*, 1864. Monogr. Foram. Crag, Appendix i, No. 98; ii, No. 99, pl. ii, figs. 36 and 37 (thick form).
POLYSTOMELLA CRISPA, var. (NONIONINA) DEPRESSULA, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 403, pl. xiv, figs. 39 *a*, *b*.
NONIONINA DEPRESSULA, *Anon.*, 1870. Science Gossip, p. 12, fig. 29.
— — *Terrigi*, 1880. Atti Acc. Pont. Nuov. Lincei, vol. xxxiii, p. 218; vol. iv, fig. 77.
— — *Brady*, 1884. 'Challenger' Report, p. 725, pl. cix, figs. 6, 7.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, p. 229, pl. xliii, fig. 25.
— — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 119, pl. x, fig. 4.
— — *Egger*, 1893. Abhand. k. Bayer. Akad. Wiss., vol. xviii, p. 427, pl. xix, figs. 38, 39.
— — *Goës*, 1894. K. Svensk. Vet.-Selsk. Akad. Handl., vol. xxv, p. 104, pl. xvii, figs. 825, 826.

Some closely allied forms are enumerated by H. B. Brady in the 'Challenger' Report, page 725; and by F. W. Millett in the Table at p. 341.

Characters.—Usually compressed; periphery nearly circular, and somewhat lobulate by the inflation of the chambers; sutures depressed; septal face more or less rounded.

The variety figured in Pl. II, figs. 36, 37, is an extraordinarily thick form; the latest chambers having widened out crosswise, until the face of the last chamber is transversely reniform, instead of being suboval and compressed.

Occurrence.—*N. depressula,* found in the Arctic seas, and abounding in the North Atlantic, occurs also in the South Atlantic, South Pacific, Red Sea, and elsewhere, usually at less than 100 fathoms. "It is the only member of the genus that is common in estuaries and brackish water pools" (H. B. Brady).

Under one name or another this form and its varieties have been described from the Eocene of Paris, the Miocene of Vienna and Calabria, the Pliocene of Rhodes, and the Post-Tertiaries of Norway and the British Islands (H. B. Brady).

The specimen here figured was collected from the Coralline Crag of Sutton by S. V. Wood some years ago.

Genus 2.—Polystomella, *Lamarck*, 1822.

Cornu ammonis, *Plancus.*

Nautilus, *Linné, Favanne, Walker and Jacob, Soldani, Gmelin, Schreibers, Fichtel and Moll, Montagu, Adams, Maton and Rackett, Pennant, Parkinson, Turton, Brown, Fleming.*

Polystomella, *Lamarck, Defrance, Blainville, d'Orbigny, Risso, Sander Rang, Menke, Deshayes, Potiez and Michaud, Michelotti, Egger, Sowerby, Brown, Macgillivray, Thorpe, Williamson, Parker and Jones, Carpenter, Wood, Seguenza, Karrer, Dawson, Brady, von Gümbel, Alcock, Parfitt, Bunzel, von Reuss, Czjzek, Rütimeyer Bronn, d'Eichwald, Schultze, Schwager, Hoernes, Abich, Terrigi, Targioni, A. Silvestri, Costa, Terquem, Reeve, Goës, Steinmann, Crouch, Harvey, Mantell, Gosse, Harting, Greene, Toula, von Zittel, Nicholson, Möbius, Hamilton, West, Hogg, Verworn, Lister, Walther, Prestwich, Mackie, Uhlig, Olszewski, Quenstedt, Bütschli, Schlumberger, Fornasini, Millett, Cooke, Neumayr, and others.*

Elphidium, Geophonus, Pelorus, Chrysolus, Andromedes, Sporilus, Themeon, and Cellanthus, *de Montfort.*

Robulina, *von Münster, d'Orbigny.*

Cristellaria, *Lamarck.*

Vorticialis, *Lamarck, Defrance, Blainville.*

Geoponus, *Ehrenberg.*

Polystomatium, *Ehrenberg.*

Nonionina, *Boll, Egger.*

Helicoza, *Möbius.*

General Characters.—Shell free, equilateral, nautiloid; convolutions numerous, the outermost embracing more or less completely all the preceding whorls; segments numerous in each convolution; their posterior margins marked by crenulations (less definite in those of simpler growth), formed by tubular retral

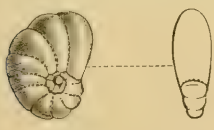
elongations of the sarcode cavity of the segment; septa narrow and limbate in the more advanced forms; septal apertures numerous, at or near the edge of the segment in contact with the edge of the previous whorl. Supplemental skeleton present; septal bridges and canal-system more or less fully developed; canals opening at the umbilicus, and by pores along the sutures. Aperture a Λ-shaped line of perforations at the base of the septal face of the last chamber.

1. Polystomella faba (*Fichtel and Moll*), 1798. Woodcuts, figs. 30 *a*, *b*.

Part I, 1866, Appendix I, Table No. 99; Appendix II, Table No. 98.

Nautilus faba, *Fichtel and Moll,* 1798. Testac. Microscop., p. 103, pl. xix, figs. *a—c*.
Chrysolus (Chrysole perlé), *Montfort,* 1808. Conch. Systém., vol. i, p. 26, No. 7.
Polystomella faba, *P. and J.*, 1860. Ann. Mag. N. H., ser. 3, vol. vi, pp. 102, 103, No. 5; and ibid., p. 339, No. 5.
Polystomella crispa, var. (Nonionina) faba, *Parker and Jones,* 1865. Phil. Trans., vol. clv, p. 402, pl. xiv, fig. 36.

Characters.—Nautiloid, somewhat elongate and compressed; chambers numerous, arcuate; sutures more or less distinctly pitted; aperture crescentic, often barred. This form, by its sutural pittings and its foraminate aperture, has passed from *Nonionina* into *Polystomella.*



Figs. 30 *a*, 30 *b*.—*Polystomella faba* (Fichtel and Moll). From the 'Philos. Trans.,' vol. clv, pl. xiv, figs. 36 *a*, *b*. × 12 diameters.

Occurrence.—*Polystomella faba* (usually referred to as a *Nonionina*) is known from the Arctic seas, and from the Adriatic. It occurs fossil in the newer Tertiaries of Italy (Tuscany).

The specimens formerly in S. V. Wood's Collection, and referred to in Part I, Appendices I and II, have been lost sight of. It is stated (in Appendix II) as having been rather common in the Coralline Crag at Sutton, and very rare in the Red Crag.

2. POLYSTOMELLA STRIATOPUNCTATA (*Fichtel and Moll*), 1798. Plate II, figs. 38, 39.

Part I, 1866, Appendices I and II, Tables, No. 97.

Nautili striati, *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 54, pl. xxxiv, figs. *ee*, *ff*.
NAUTILUS STRIATOPUNCTATUS, *Fichtel and Moll*, 1798. Test. Micr., p. 61, pl. ix, figs. *a—c*.
ROBULINA SULCATA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 289, No. 10.
POLYSTOMELLA POEYANA, *d'Orb.*, 1839. Foram. Cuba, p. 75, pl. vi, figs. 25, 26.
— ARTICULATA, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 30, pl. iii, figs. 9, 10.
GEOPONUS STELLA-BOREALIS, *Ehrenberg*, 1839. Abhandl. k. Akad. Wiss. Berlin, p. 132, pl. i, figs. *a—g*.
POLYSTOMELLA GIBBA, *Schultze*, 1854. Organ. Polyth., p. 66, pl. vi, figs. 1—4.
— STELLA-BOREALIS, *Schultze*, 1854. Ibid., p. 67, pl. vi, figs. 5, 6.
— VENUSTA, *Schultze*, 1854. Ibid., figs. 7—9.
NONIONINA STRIATOPUNCTATA, *Parker and Jones*, 1857. Ann. Mag. N. H., ser. 2, vol. xix, p. 288, No. 12.
POLYSTOMELLA CRISPA, *Parker and Jones*, 1857. Ibid., No. 13, pl. xi, fig. 19.
NONIONINA HETEROPORA, *Egger*, 1857. Neues Jahrb. für Min., &c., p. 300, pl. xiv, figs. 19—21.
POLYSTOMELLA CRYPTOSTOMA, *Egger*, 1857. Ibid., p. 301, pl. ix, figs. 19, 20.
— SUBCARINATA, *Egger*, 1857. Ibid., p. 301, pl. xiv, figs. 24, 25.
— ANGULATA, *Egger*, 1857. Ibid., p. 302, pl. xv, figs. 5, 6.
— UMBILICATULA, *Williamson*, 1858. Rec. For. Gt. Br., p. 42, pl. iii, figs. 81, 82.
— — var. INCERTA, *Williamson*, 1858. Ibid., p. 44, pl. iii, fig. 82 *a*.
— — *J. W. Dawson*, 1859. Canad. Nat., vol. iv, p. 27, fig. 1 ("*striatopunctata*," 1865).
— INFLATA, *Reuss*, 1860. Sitzungsb. k. Ak. Wiss. Wien, vol. xlii, p. 358, pl. i, figs. 10 *a*, *b*.
— STRIATOPUNCTATA, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. v, p. 103, No. 6.
— — *Carpenter*, 1862. Introd. Foram., p. 287.
— — *P. and J.*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 434, No. 26.
— MINUTA, *Reuss*, 1864. Sitzungsb. k. Ak. Wiss. Wien, vol. l, p. 478, pl. iv, figs. 6 *a*, *b*.
— DISCREPANS, *Reuss*, 1864. Ibid., figs. 7 *a*, *b*.
— LATIDORSATA, *Reuss*, 1864. Denkschr. k. Akad. Wiss. Wien, vol. xxiii, p. 10, pl. i, figs. 16 *a*, *b*.

POLYSTOMELLA STRIATOPUNCTATA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 89; *Idem*, 1865, Nat. Hist. Trans. Northd. and Durham, vol. i, p. 106, No. 2.

— — *J. W. Dawson*, 1865. Canadian Nat., n. s., vol. ii, p. 86.

— CRISPA, var. (NONIONINA) STRIATOPUNCTATA, *Sars*, 1865. Foss. Dyrelevn. Qvartærperioden, p. 11.

— — — — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 402, pl. xiv, figs. 31—34; pl. xvii, figs. 60 *a*, *b*.

— STRIATOPUNCTATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendix, Tables, No. 97, pl. ii, figs. 38, 39.

— — *Sars*, 1868. Christiania Vidensk.-Selsk. Forhandl. for 1868, p. 249.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 351; and Trans. Geol. Soc. Glasgow, vol. iii, p. 125.

— CRISPA, *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, 1869, p. 416, fig. 33.

— UMBILICATULA, *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 70.

— CRISPA, var. STRIATOPUNCTATA, *G. M. Dawson*, 1870. Canad. Nat., new ser., vol. v, p. 179.

— STRIATOPUNCTATA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, pp. 305, 306.

— — *Parker, Jones, and Brady*, 1871. Ibid., ser. 4, vol. viii, p. 239, No. 101; and p. 241, No. 112, pl. xii, fig. 156.

— CRISPA, var. STRIATOPUNCTATA, *J. W. Dawson*, 1872. Canad. Nat., n. s., vol. vi, p. 255, pl. iii, fig. 2.

— STRIATOPUNCTATA, *Williamson*, 1872. Mem. Lit. Phil. Soc. Manchester, ser. 3, vol. v, p. 134; see also vol. viii, 1847, p. 44, pl. ii, fig. 30.

— EXCAVATA, et var., *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 25, pl. ii, figs. 2 *a*—*f*.

— UMBILICATULA, *Terquem*, 1875. Ibid., figs. 3 *a*, *b*.

— STRIATOPUNCTATA, *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.

— — *Schulze*, 1877. Arch. Mikr. Anat., vol. xiii, p. 9, pl. ii, figs. 4—6.

— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., part 2, p. 56.

— MINIMA, *Seguenza*, 1879. Atti R. Accad. Lincei, ser 3, vol. vi, p. 333, pl. xvii, fig. 38.

POLYSTOMELLA STRIATOPUNCTATA, *Terrigi*, 1880. Atti Accad. Pontif. N. Linc., ann. xxxiii, p. 216, pl. iv, figs. 73, 74.
— ANTONINA, *Terquem*, 1882. Mém. Soc. géol. France, sér. 3, vol. ii, p. 47, pl. ii (x), figs. 25 *a*, *b*.
— STRIATOPUNCTATA, *Jones*, 1883. Microgr. Dict., ed. 4, p. 623, pl. xxiv, fig. 19.
— — *Brady*, 1884. Report 'Challenger,' p. 733, pl. cix, figs. 22, 23.
— CRISPA, *J. W. Dawson*, 1886. Handb. Zool., ed. 3, p. 45, fig. 37.
— STRIATOPUNCTATA, *Brady*, 1887. Journ. Roy. Micr. Soc., p. 926.
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, p. 161.
— — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 230, pl. xliii, fig. 17.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 433, pl. xix, figs. 49, 50.
— — (partim), *Goës*, 1894. K. Sven. Vet.-Ak. Handl., vol. xxv, No. 9, p. 101, pl. xvii, figs. 815 *c—l, o, p, s, t*, 817, 818, 819.
— — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 78.

Characters.—Shell nautiloid, rather compressed, the outermost convolution concealing the previous whorls; segments numerous, arcuate, somewhat ventricose; margin rounded and more or less lobulated; septal lines and umbilicus generally depressed; septal bridges (retral processes) well developed; aperture variable.

Polystomella striatopunctata differs from the type (*P. crispa*) in the generally smooth condition of the shell and its rounded margin. It is the principal representative of the genus in brackish and shallow waters, under enfeebling external conditions. It seldom attains any considerable size, and has often a very thin and delicate shell.

Occurrence.—This species is practically cosmopolitan, but its habitat is in comparatively shallow water. It is most frequently met with at depths ranging from the shore-line to 100 fathoms. It is, however, not unfrequently found at depths down to 600 fathoms, and occasionally in still deeper water.

Fossil specimens have been recorded from the Eocene (London Clay and Calcaire Grossier); from the Oligocene of Germany; from the Miocene of Vienna, Bavaria, and Malaga; from the Pliocene of Antwerp, Italy, and St. Erth; and from the Pleistocene generally. In the Coralline Crag we have somewhat rare specimens from nearly every zone examined; and it has been found, as stated in the First Part of the Monograph, throughout the Upper Crag.

3. Polystomella crispa (*Linné*), 1767. Plate II, figs. 40—43.

Part I, 1866, Appendices I and II, Tables, No. 95.

Cornu Hammonis minus vulgare, Orbiculatum, &c., *Plancus*, 1739. Conch. minus notis, Edit. Venet. (and Edit. Romæ, 1760), p. 10, pl. i, figs. 2 D, E, F.

Nautilus minimus, &c., *Gaultieri*, 1742. Index Test. Conch., pl. xix, figs. A and D.

Nautilus crispus, *Linné*, 1758. Syst. Nat., ed. 10, p. 709, No. 235; edit. 12, p. 1162, No. 275; edit. 13 (Gmelin's), p. 3370, No. 3.

Cornu Hammonis, *Ledermüller*, 1760. Mikroscopisch. Gemüths, &c., p. 16, pl. viii, fig. *b*.

Nautilus tabulatus, minimus, umbilicatus, marginatus, et granulatus, *Martini*, 1768. N. Syst. Conch.-Cab., p. 250, pl. xx, figs. 172—174.

Nautilo, *Targioni*, 1770. Relaz. Viaggia, vol. iv, p. 8, pl. i, figs. 6—8.

Nautile microscopique granuleux, *D'Argenville* (*Favanne*), 1780. Conchyliologie, vol. i, p. 680, pl. vii, fig. B 1; p. 728, pl. lxix, fig. D 2.

Nautilus crispus, *Spengler*, 1781. Nye Saml. k. Danske Selsk. Skr., vol. i, p. 368 [pl. i], figs. 1 *a*—*c*.

Nautilus spiralis geniculis crenatis, *Walker and Boys*, 1784. Test. Min. Rar., p. 18, pl. iii, fig. 65.

Nautilus crispus, *Adams*, 1787. Essays Microsc., p. 640, pl. xiv, fig. 30.

Nautili *striati communes* (*crispi*, Linnæi), *Soldani*, 1789. Testaceogr., vol. i, part 1, p. 54, pl. xxxiii, fig. F; and pl. xxxiv, figs. G, H (umbonate *P. crispæ*); and fig. I (impoverished *P. strigillata*, between *crispa* and *macella*).

Hammonia *crispa*, *Soldani*, 1789. Ibid., p. 54, pl. xxxiv, fig. *cc* (an explanate *Polystomella*, near *P. macella*).

Nautilus crispus, *Fichtel and Moll*, 1798. Test. Microsc., p. 40, pl. iv, figs. *d*—*f*; and pl. v, figs. *a*, *b*.

— *ambiguus*,[1] *F. and M.*, 1798, p. 62, pl. ix, figs. *d*—*f*.

— crispus, *Kanmacher* (*Walker and Jacob*), 1798. In Adams's Essays Microsc., 2nd edit., p. 640, pl. xiv, fig. 30.

— — *Pulteney*, 1813. Hutchins's Hist. Dorset, 2nd edit., vol. iii, p. 42, pl. xix, fig. 29.

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[1] *Nautilus ambiguus*, F. and M., although possibly a *Peneropolis*, has the angular row of perforations representing the aperture typical of *Polystomella*; and, if it be the latter, *P. ambigua* (F. and M.) is one of the varieties ranging between *striatopunctata* and *crispa*. It is much like *P. Listeri*, d'Orb., 'For. Foss. Vien.,' pl. vi, figs. 19—22. On the same plate d'Orbigny has figured other closely related varieties, as *P. Hauerina*, figs. 1, 2; *rugosa*, figs. 3, 4; *obtusa*, figs. 5, 6; and *Antonina*, figs. 17, 18.

NAUTILUS CRISPUS, *Montagu*, 1803. Test. Brit., p. 187, Suppl., 1808, pl. xviii, fig. 5.
— — *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 115.
THEMEON RIGATUS, *Montfort*, 1808. Conchyl. Systém., vol. i, p. 202, 51e genre.
NAUTILUS CRISPUS, *Parkinson*, 1811. Org. Rem. Former World, vol. iii, p. 107, pl. xi, fig. 25.
POLYSTOMELLA CRISPA, *Lamarck*, 1822. Anim. sans Vert., vol. vii, p. 625, No. 1.
VORTICIALIS CRISPA, *Defrance*, 1824. Dict. Sci. Nat., vol. xxxii, p. 181; and *Blainville*, 1825, Malacologie, p. 375.
NAUTILUS CRISPUS, *Wood*, 1825. Index Testac., p. 63, pl. xiii, fig. 8.
— AMBIGUUS, *Wood*, 1825. Ibid., p. 66, pl. xiii, fig. 58.
POLYSTOMELLA CRISPA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 283, No. 1; Modèle, No. 45.
— — *Crouch*, 1827. Introd. Conch., p. 41, pl. xx, fig. 14.
NAUTILUS CRISPUS, *Brown*, 1827. Illustr. Conch. Gt. Brit., fly-leaf, pl. lii, fig. 6.
POLYSTOMELLA OWENIANA, *d'Orbigny*, 1839. Foram. Amér. Mérid., p. 30, pl. iii, figs. 3, 4.
LANIERI, *d'Orbigny*, 1839. Foram. Cuba, p. 74, pl. vii, figs. 12, 13.
CRISPA, *Brown*, 1843. Foss. Conch., p. 22, pl. ii, fig. 15.
— — 1844. Illustr. Conch. Gt. Brit., edit. 2, pp. 1 and 145, pl. i, fig. 6.
— — *Reuss*, 1845. Geinitz's Grundriss, p. 647, pl. xxiv, fig. 43.
— — *d'Orb.*, 1846. For. Foss. Vien., p. 125, pl. vi, figs. 9—14.
— FLEXUOSA, *d'Orb.*, 1846. Ibid., p. 127, pl. vi, figs. 15, 16.
— CRISPA, var., *Williamson*, 1848. Mem. Lit. Phil. Soc. Manchester, vol. viii, p. 44, pl. xxx; *P. striatopunctata*, Ibid., ser. 3, vol. v, 1872, p. 134.
— — *Williamson*, 1848. Trans. Micr. Soc. Lond., vol. ii, p. 159, pl. xxviii, figs. 1—7.
— FLEXUOSA, *Reuss*, 1849. Denksch. k. Akad. Wiss. Wien, vol. i, p. 370, pl. xlviii, fig. 3.
— CRISPA, *Mantell*, 1850. Pictor. Atlas, p. 144, pl. lxii, fig. 25.
— — *Williamson*, 1852. Trans. Micr. Soc., vol. iii, p. 123, pl. xviii, fig. 19.
— — *Bronn*, 1853-6. Lethæa Geogn., edit. 3, vol. iii, p. 204, pl. xxxv^2, figs. 6 *a*, *b*.
— STRIGILATA, *Schultze*, 1854. Organ. Polythal., p. 64, pl. iv.
— CRISPA, *Gosse*, 1855. Man. Mar. Zool., p. 12, fig. 14.
— — *Costa*, 1856. Atti Accad. Pontan., p. 212, vol. vii, pl. xiv, figs. 11 *a*, A, B.
NONIONINA? HELICINA,[1] *Costa*, 1856. Ibid., pl. xiv, figs. 13 A, B, C (near our Pl. II, figs. 42, 43).

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[1] If this be a true *Polystomella*, it is an example of the combined characters of "covered" and "uncovered" sides. See page 338.

POLYSTOMELLA SPINULOSA, *Costa*, 1856. Atti Accad. Pontan., p. 212, vol. vii, pl. xix, figs. 14 A, B, C.

— ORNATA, *Costa*, 1856. Ibid., p. 215, pl. xix, figs. 16 A, B.

— CRISPA, *Costa*, 1856. Ibid., p. 212, pl. xix, figs. 17 A, B, C.

— STRIOLATA, *Costa*, 1856. Ibid., figs. 15 A, B, and 18 A, B.

— DEPRESSULA, *G. B. Sowerby*, 1856. Foram. Colne River, p. 1, fig. 1.

— CALCAR, *G. B. Sowerby*, 1856. Foram. Colne River, p. 1, fig. 4.

— CRISPA, *Egger*, 1857. Neues Jahrb. für Min., Jahrg. 1857, p. 303, pl. xv, figs. 1, 2.

— — *Parker and Jones*, 1857. Ann. Nat. Hist., ser. 2, vol. xix, p. 288, pl. xi, fig. 19.

— — *Williamson*, 1858. Rec. For. Gt. Br., p. 40, pl. iii, figs. 78—80.

— — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iii, p. 479.

— — *Carpenter*, 1860. Phil. Trans., vol. cl, p. 535, pl. xvii, figs. 9, 10.

— — — 1862. Introd. Foram., p. 278, pl. xvi, figs. 4—6.

— — *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 399, pl. xiv, fig. 24; pl. xvii, figs. 61 *a*, *b*.

— — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 26, No. 45, pl. iii, fig. 96 (aperture wrong).

— — *Hartwig*, 1866. The Sea, edit. 3, p. 381, fig. *c*.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append., Tables, No. 95, pl. ii, figs. 40—43.

— — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vii, p. 351; Trans. Geol. Soc. Glas., vol. iii, p. 125.

— — *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, pp. 239 and 266, No. 102, pl. xii, fig. 155.

— — *Greene*, 1871. Manual Protoz., p. 15, fig. 3 *c*.

— — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.

— — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 24, pl. i, figs. 19 *a*, *b*.

— — *Toula*, 1875. Mitth. Geogr. Ges. Wien, vol. xviii, p. 165, fig. 20.

— — *Zittel*, 1876. Handb. Palæont., vol. i, p. 101, fig. 41.

— — *Schwager*, 1877. Boll. Soc. Geol. Ital., vol. viii, p. 25, fig. 16.

— — *Siddall*, 1878. Proc. Chester Soc. N. Sci., pt. 2, p. 56.

— — *Nicholson*, 1879. Manual Pal., vol. i, p. 118, fig. 18[s].

— — *Terrigi*, 1880. Att. Acc. P. N. Lincei, vol. xxxiii, p. 214, pl. iv, figs. 71, 72.

— COSTIFERA, *Terquem*, 1882. Mém. Soc. Géol. France, sér. 3, vol. ii, Mém. iii, p. 47, pl. ii (x), fig. 26.

POLYSTOMELLA CRISPA, var. POËYANA, *Goës*, 1882. K. Sv. Vet.-Akad. Handl., vol. xix, No. 4, p. 116, pl. viii, figs. 301, 302.
— — *Jones*, 1883. Micr. Dict., edit. 4, p. 623, pl. xxiii, fig. 55; pl. xxiv, figs. 20 *a*, *b*.
— — *West*, 1883. J. Post. M. S., vol. ii [5], p. 41, pl. xxi, figs. 1—3.
— — *Brady*, 1884. 'Challenger' Rep., p. 736, pl. cx, figs. 6, 7.
— — *Basset*, 1884. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 162, fig. 45.
— *Gümbel*, 1886. Geol. Bayern., vol. i, pt. 2, p. 421, fig. 266[25].
— — *Hogg*, 1886. Microsc., p. 375, fig. 207[3].
— — *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. v, pp. 142, 158—160.
— — *Brady*, 1887. Journ. R. Micr. Soc., p. 926.
— — *Steinmann*, 1888. Elem. Pal., vol. i, p. 32, fig. 17 A.
— FLEXUOSA, *Walther*, 1888. Mitth. Zool. Stat. Neapel, vol. viii, pp. 382, 383, pl. xx, fig. 5.
— CRISPA, *Prestwich*, 1888. Geology, vol. ii, p. 420, fig. 210 *a*.
— — [*Chapman*], 1888. Scient. News, May, p. 413, fig. 18.
— — *Verworn*, 1888. Zeit. Wiss. Zool., vol. xlvi, p. 462, pl. xxxii, figs. 7, 8, 9, and *g*, *h*, *i*; Ann. Mag. Nat. Hist., ser. 6, vol. ii, p. 161, pl. ix, figs. 4—6.
— — *Terrigi*, 1891. Mem. Descriz. Carta Geol. d'Italia, vol. iv, p. 110.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 432, pl. xx, figs. 20, 21.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 460.
— — *A. Silvestri*, 1893. Atti Red. Acc. Zelanti Acireale, vol. v, p. 21, pl. iii, figs. 28, 29.
— — *Goës*, 1894. K. Sven. Vet.-Ak. Handl., vol. xxv, No. 9, p. 102, pl. xvii, figs. 820—822. Fig. 822 is a thick-edged form, like our figs. 42, 43.
— — *Fornasini*, 1894. Foram. Coll. Sold., Sagg. Oritt., pp. 9—11, and 21.

Characters.—Shell lenticular, spiral, showing only the outermost convolution, which consists of numerous narrow, arcuate, flexuose segments. Anterior border of each segment prominent, smooth, forming a raised septal line—the central portion and posterior border more depressed, sometimes concave; sculptured into numerous transverse crenulations, most conspicuous near their junction with the preceding segment. Peripheral margin thin, sometimes carinate, occasionally furnished with tubercular or spinous processes projecting from the septal ridges. Apertures numerous, arranged in a Λ-shaped series, close to the surface of the antecedent convolution.

Pl. II, figs. 40 and 41, represent the typical form of *P. crispa;* in figs. 42 and 43 we have a smaller and relatively thicker form, more compressed, and retaining more of the characters of *P. striatopunctata.*

Occurrence.—Polystomella crispa is very common, and has practically a world-wide range, but is confined to comparatively shallow waters. The bathymetrical range extends from the littoral zone to 355 fathoms; it is one of the most common species on our own coasts.

Fossil specimens have been recorded from the Eocene of the Paris Basin; from the Oligocene of Germany; from the Miocene of Malaga, Italy, Vienna, and elsewhere; from the Pliocene of Italy, Spain (Garrucha), and St. Erth; and from the Pleistocene generally. We have met with the species in every zone of the Coralline Crag examined; and, as recorded in the First Part of the Monograph, it occurs throughout the Upper Crag.

4. Polystomella macella (*Fichtel and Moll*), 1803. Plate VII, figs. 35 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 96.

Ammonia seu Nautilus, &c., *Soldani*, 1780. Saggio Oritt., p. 104, pl. iii, fig. 8.
Nautilus *striatus communis*, *Soldani*, 1789. Testaceographia, vol. i, pt. i, p. 54, pl. 34, fig. *cc*.
— macellus, *Fichtel and Moll*, 1798. Test. Micr., p. 66, var. *α*, pl. x, figs. *e—g*; var. *β*, pl. x, figs. *h—k*.
Elphidium (L'Elphide souflé), *Montfort*, 1808. Conchyl. Systém., vol. i, p. 14, genre 4.
Geophonus (Le Géopone jaune), *Montfort*, 1808. Ibid., p. 18, genre 5.
Polystomella planulata, *Lamarck*, 1822. Anim. sans Vert., vol. vii, p. 625, No. 3.
— macella, *Blainville*, 1824. Dict. Sci. Nat., vol. xxxii, p. 183.
— planulata, *Blainville*, 1824. Ibid., Atlas Conch., pl. xv, fig. 8.
— macella, *Blainville*, 1825. Malac., p. 388.
— planulata, *Blainville*, 1825. Ibid., pl. vii, fig. 8.
Nautilus macellus, *Wood*, 1825. Index Testac., p. 63, pl. xiv, fig. 45.
Polystomella strigilata (in part), *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 284, No. 4.
— Lessonii, *d'Orb.*, 1826. Ibid., No. 6.
— — — 1840. Foram. Amér. Mérid., p. 29, pl. iii, figs. 1, 2.
— Fichteliana, *d'Orb.*, 1846. For. Foss. Vien., p. 125, pl. vi, figs. 7, 8.
— Ortenburgensis, *Egger*, 1857. Neues Jahrb. für Min., &c., p. 302, pl. xv, figs. 7, 9.

POLYSTOMELLA MACELLA, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., ser. 3, vol. v, p. 104, No. 8; p. 290, No. 70; vol. vi, p. 339, Nos. 2, 3.
— TENUISSIMA, *Karrer*, 1864. Novara-Exped. geol. Theil, vol. i, p. 83, pl. xvi, fig. 16.
— MACELLA, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 239, No. 101, pl. xii, fig. 154.
— LAMINATA, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 16, pl. i (vi), figs. 8 *a, b*.
— — — 1882. Ibid., vol. ii, Mém. iii, p. 47, pl. ii (x), figs. 24 *a, b*.
— MACELLA, *Brady*, 1884. 'Challenger' Report, p. 737, pl. cx, figs. 8—11.
— — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 563, pl. xi, figs. 26 *a, b*.
— — *Egger*, 1883. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 432, pl. xx, figs. 22, 23.

Characters.—Compressed, explanate, umbilicus depressed; margin more or less acute; chambers narrow, curved.

So far as essential particulars are concerned, the description of *Polystomella crispa* would apply equally to *P. macella.* There are, however, distinctions which tend to place *P. macella* in the light of a starved modification of the type. *P. macella*, whilst having a lateral surface as large as that of *P. crispa*, is much thinner than the typical form, and is subject, as shown in Fichtel and Moll's figures, to lateral deviations from the symmetrical plan of growth. The peripheral margin is generally even, and not tubercular or spinose as in *P. crispa*, *P. regina*, &c.

Occurrence.—*Polystomella macella* is stated by Brady in the 'Challenger' Report to be "not common in the Northern Temperate Zone; the Mediterranean and the Adriatic being apparently its boreal limit." We have, however, well-marked specimens in our own collection from the southern coast of England. The published records show that it is very generally distributed as a shallow-water form as far south as Kerguelen.

Its geological range, so far as is at present known, extends to the Middle Jurassic of Russia. It has also been recorded from the Red Chalk of Speeton; from the Eocene of the Paris Basin; from the Miocene of Vienna, Bavaria, and Muddy Creek, Victoria; from the Pliocene of Italy, Kar Nicobar, Isle of Rhodes, and St. Erth. It is not uncommon as a Pleistocene fossil. In the Coralline Crag we have found specimens in every zone examined; but, unlike *P. crispa*, the species has not been found in the Upper Crag.

Sub-family 2.—Nummulitinæ.

Brady, '*Challenger*' *Report*, 1884, *p.* 75.

Test lenticular or complanate; lower forms with thickened and finely tubulated shell-wall, but no intermediate skeleton; higher forms with interseptal skeleton and complex canal-system.

Genus 1.—Amphistegina, *d'Orbigny*, 1826.

Carpenter, *Phil. Trans.*, *vol. cxlix*, 1859, *pp.* 30—35; *Introd. Foram.*, 1862, *pp.* 241—247, *pl. xciii*, *figs.* 22—29; *Brady*, *Report* '*Challenger*,' 1884, *pp.* 75 *and* 739.

Amphistegina, *d'Orbigny*, *Bronn*, *von Reuss*, *Roemer*, *Cuvier*, *Pictet*, *Suess*, *Williamson*, *Ehrenberg*, *Carpenter*, *Parker and Jones*, *Karrer*, *Pourtales*, *Kaufmann*, *Möbius*, *Brady*, *Abich*, *von Gümbel*, *Terquem*, *Harting*, *Bunzel* (?), *von Zittel*, *Schwager*, *Credner*, *de Lapparent*, *de Amicis*, *Nicholson*, *Bütschli*, *Steinmann*, *Terrigi*, *Smedley*, *Bassett*, *Kölliker*, *Chapman*, *and others*.
Heterostegina, Nonionina, *Ehrenberg*.
Hemistegina, *Kaufmann*.

General Characters.—Shell free, lenticular, umbonate, inequilateral, more convex on one side than the other; consisting of a turbinoid spire, each convolution completely embracing the previous whorl. Chambers saddle-shaped (equitant), the alar prolongations on the upper side simple (as in *Nummulites*), on the lower divided each into two portions by the constriction of the sarcode; the secondary lobes being directed backwards and radially, and being intercalated have the appearance externally of an independent whorl of chambers. Aperture on the lower side of the ultimate chamber (as in the Rotalinæ).

The structural peculiarities of the genus *Amphistegina* are treated at length in Dr. Carpenter's 'Introduction,' &c., p. 241, *et seq.*

Amphistegina vulgaris, *d'Orbigny*, 1823. Plate II, figs. 46—48.

Part I, 1866, Appendix I, Table, No. 92; Appendix II, Table, No. 91.

Lenticula, *Soldani*, 1780. Sagg. Oritt., p. 106, pl. iv, figs. 32 *e*, *E*; and pl. vii, figs. *zz*, *ZZ* (?); Testaceogr., vol. ii, App., p. 140 (Ammonia), and p. 141 (same pl. and figs.).

AMPHISTEGINA VULGARIS, *d'Orbigny*, 1823. Modèles, Livraison 2^{e}, No. 40; Annales Sci. Nat., vol. vii, 1826, p. 305, No. 8.
ROBULINA NITIDA (?), *d'Orb.*, 1826. Ibid., p. 290, No. 22.
AMPHISTEGINA GIBBOSA, *d'Orb.*, 1839. Foram. Cuba, p. 120, pl. viii, figs. 1—3.
— — *Williamson*, 1852. Trans. Micr. Soc. Lond., vol. iii, p. 105, pl. xvii, figs. 1, 2.
— VULGARIS, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 147 (Table); and Ann. Mag. Nat. Hist., ser. 3, vol. xii, 1863, pp. 430, 438, No. 1.
— — *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 25, No. 40, pl. iii, fig. 91; and p. 34, No. 98, pl. iii, fig. 92.

Amphistegina vulgaris, d'Orb., was adopted by Parker and Jones as the natural type of the genus (see references given above); and, moreover, it has priority as a *published* form (Modèle, No. 40 in livraison 2) over *A. Lessonii* (Modèle, No. 98 in livraison 4), although the latter comes first in d'Orbigny's catalogue in the 'Annales Sci. Nat.,' vol. vii, p. 304, and has therefore been regarded as the "type" by various writers. Besides *A. Lessonii* several other varieties are enumerated in Brady's list of synonyms in the 'Challenger' Report, pp. 740, 741. All of these and others can be grouped around *A. vulgaris* as indicated by Parker and Jones in 1863 and 1865 on zoological grounds.

The following are the most important references to *Amphistegina* since the publication of the 'Challenger' Report, 1884, or not included in it.

AMPHISTEGINA VULGARIS, *J., P., and B.*, 1866. Monogr. For. Crag, Appendices, pl. ii, figs. 46—48.
— (?), *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 243, No. 118, pl. xii, fig. 152.
— VULGARIS, *Terquem*, 1875. Plage Dunk., p. 36, pl. v, figs. 8 *a*, *b*.
— — *Jones*, 1882. Catal. Foss. Foram. B. Mus., pp. 44, 67, 73, 74, 79, 94.
— LESSONII (including *vulgaris*, &c.), *Brady*, 1884. Report 'Challenger,' pp. 740, 741, pl. cxi, figs. 1—7.
— HAUERI, *Gümbel*, 1885. Geol. Bayer., vol. i, pt. 2, p. 423.
— (?), *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 152, No. 43.
— LESSONII, *De Amicis*, 1893. Ibid., vol. xii, p. 462.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 431, pl. xx, figs. 18, 19.
— — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 55 and 63.
— — *Chapman*, 1895. Proceed. Zool. Soc. for 1895, p. 45.
AMPHISTEGINA VULGARIS, *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 79.

Characters.—Shell lenticular, unequally biconvex, umbonate; chambers numerous; septal lines sinuous on the upper, curved and astral on the lower surface; margin acute; surface smooth.

Distribution.—*Amphistegina vulgaris* (including *Lessonii*) is mostly confined to tropical and subtropical seas; and, as a rule, does not extend to depths beyond 400 fathoms, and is most common at depths of less than 30 fathoms. Rare specimens have, nevertheless, been recorded from much greater depths—1750 fathoms by the 'Challenger,' and 2714 fathoms (*A. Hauerina*) by the 'Gazelle.'

Dr. A. Goës found this species at 20, 100, 300, and 1000 fathoms in the Caribbean Sea.

The genus in the fossil condition has been recorded from the Carboniferous of Bristol (H. B. Brady); the species from the Eocene of France (Calcaire Grossier); of Bavaria (Nummulitic beds of the Traunstein, Ehrenberg); and (?) of Java (Orbitoidal Limestone, Ehrenberg).

It is, perhaps, the most characteristic Foraminifer of the Miocene deposits generally; and it has been found in the Pliocene of many localities, especially in Italy, also at St. Erth. We include *Amphistegina vulgaris* as a constituent of the Crag rhizopodal fauna with some reservation. The specimens from Sudbourne found by Mr. S. V. Wood seem to carry evidence of having been washed from some earlier formation.

Genus 2.—Operculina, *d'Orbigny*, 1826.

Carpenter, *Introd. Foram.*, 1862, *pp.* 247—262, *pl. xvii*; *Brady*, *Report 'Challenger,'* 1884, *pp.* 76, 742.

Nautilus, *Gronovius, Schroeter, Gmelin.*
Lenticulites, *Defrance, Basterot.*
Operculina, *d'Orbigny, Bronn, Michelotti, von Reuss, Leymerie, Cornuel, Rütimeyer, d'Archiac and Haime, Carter, Parker and Jones, Carpenter, Brady, M. Sars, Kaufmann, von Hantken, Vine, Quenstedt, Schafhäutl, Schauroth, von Gümbel, Schwager, Michelotti, Brown, T. Wright, von Zittel, Locard, Steinmann, Pictet, Mayer, M. Chalmas, Galeotti, Terquem, Ansted, Kölliker, Williamson, Figuier, Bütschli, Woodward and Thomas, &c.*
Amphistegina, *d'Orbigny, von Reuss.*
Nonionina, *Williamson, Fischer.*
Nummulina, *Parker and Jones.*

General Characters.—Shell free, equilateral, plano-spiral; formed of a regular spire, the successive convolutions of which are in close contact without over-

lapping, and are equally visible on both sides of the shell. Chambers numerous, rapidly increasing in size. Aperture simple at the inner margin of the chamber, as in *Nummulites*, from which genus *Operculina* differs in its delicate and more explanate shell, and more rapid increase of size in successive whorls. Canal system well developed.

1. Operculina complanata, *Defrance*, 1822. Plate II, figs. 49, 50.

Part I, 1866, Appendix I, Table No. 94; Appendix II, Table No. 93.

Lenticulites complanata, *Defrance*, 1822. Dict. Sci. Nat., vol. xxv, p. 453.
— — *Basterot*, 1825. Mém. Géol. Env. Bordeaux, pt. 1, p. 18.
Operculina complanata, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 281, pl. xiv, figs. 7—10; Modèle, No. 80.
— — *Michelotti*, 1841. Mem. Soc. Ital. Sci., vol. xxii, p. 285, pl. ii, figs. 1 *a*, *b*.
— — *Reuss*, 1845. In Geinitz's Grundriss, p. 665, pl. xxiv, fig. 41.
— ammonea, *Leymerie*, 1846. Mém. Soc. Géol. France, sér. 2, vol. i, p. 359, pl. xiii, figs. 11 *a*, *b*.
— complanata, *Rütimeyer*, 1850. Nouv. Mém. Soc. Helvet. Sci. Nat., vol. xi, Mém. 2, p. 108, pl. iv, fig. 56.
— arabica, *Carter*, 1852. Ann. Mag. Nat. Hist., ser. 2, vol. x, pp. 161—176, pl. iv, figs. 1—9.
— — — 1853. Journ. Bombay Branch R. Asiatic Soc., vol. iv, p. 437, pl. xviii.
— Hardiei, *d'Archiac and Haime*, 1854. Foss. Nummulit. Inde, livr. 2, p. 346, pl. xxxv, figs. 6, 6 *a—c*, granulose.
— complanata, *Bronn*, 1853-6. Lethæa Geogn., edit. 3, vol. iii, p. 208, pl. xxxv^2, figs. 7 *a—d*.
— — *T. Wright*, 1855. Ann. Mag. Nat. Hist., ser. 2, vol. xv, p. 75, pl. vii, figs. 4 *a*, *b*.
— — *Carpenter*, 1859. Phil. Trans., vol. cxlix, pp. 12—30, pl. iv; pl. v, figs. 1—12; pl. vi, figs. 1—4.
— — *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 149, Tables.
— arabica, *Carter*, 1861. Ann. Mag. Nat. Hist., ser. 3, vol. viii, pp. 309—320, pl. xvii, figs. 10—14.
— complanata, *Parker and Jones*, 1861. Ibid., ser. 3, vol. viii, p. 229.
— — *Michelotti*, 1861. Nat. Verh. Holl. Maatsch-wet., ser. 2, vol. xv, p. 20, pl. i, figs. 14, 15.
— — *Carpenter*, 1862. Introd. Foram., p. 247, pl. xvii.

Operculina complanata, *Parker and Jones*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 207, No. 36; p. 435, No. 36; and p. 440, No. 15.
— — *Parker, Jones, and Brady*, 1865. Ibid., vol. xvi, p. 32, pl. iii, fig. 93.
— — *Jones, Parker, and Brady*, 1866. Monogr. For. Crag, Append. i and ii, Tables, Nos. 93, 94, pl. ii, figs. 49, 50.
— Studeri, *Kaufmann*, 1867. Geol. Beschreib. Pilatus, p. 151, pl. ix, figs. 1, 2.
— marginata, *Kaufmann*, 1867. Ibid., p. 152, pl. ix, fig. 4.
— complanata, *Zittel*, 1876. Handb. Pal., vol. i, p. 96, fig. 36.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, fig. 22.
— — *Locard*, 1877. Ann. Agric. Lyon, ser. 4, vol. ix, p. 231, pl. v, figs. 6, 7.
— — *Jones*, 1882. Catal. Foss. Foram. Brit. Mus., pp. 22, 36, 40, 53, 69, 73, 80, 94.
— — *Möbius*, 1880. Foram. Mauritius, p. 104.
— Arabica, *Jones*, 1883. Micrc gr. Dict., p. 555, pl. xxiv, figs. 23—26.
— complanata, *Brady*, 1884. 'Challenger' Report, p. 743, pl. cxii, figs. 3—5, 8.
— — *Basset*, 1885. Ann. Soc. Sci. Nat. Charente-Inf., No. 21, p. 162, fig. 80.
— — *Woodward and Thomas*, 1885. Thirteenth Rep. Geol. Surv. Minnesota, p. 175, pl. iv, fig. 35.
— — *Gümbel*, 1885. Geol. Bayer., vol. i, part 2, p. 421, fig. 266[28].
— — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, p. 435, pl. xx, figs. 40—42.
— — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 464.
— — *Woodward and Thomas*, 1895. Final Report Geol. Surv. Minnesota, vol. iii, part 1, p. 45, pl. E, figs. 37 and 39.
— — *Chapman*, 1895. Proc. Zool. Soc. for 1895, p. 47.

Characters.—Shell discoidal, complanate, subumbonate; consisting of three or four revolutions, rapidly increasing in breadth; chambers numerous, radial or arcuate; septa subtranslucent, sometimes limbate.

Distribution.—*Operculina complanata* is essentially a shallow-water form, and is confined to tropical and subtropical seas. No specimens have been obtained from the Atlantic. *O. ammonoides* represents it in the North Atlantic.

Fossil in the Chalk of Maestrichtand Minnesota; in the Eocene of Central Europe and India; in the Miocene of Italy and of Muddy Creek (Victoria); and in great profusion in the Langhian of the Bordeaux area. So far as the

Crag is concerned *Operculina complanata* was found in company with the *Nummulites Boucheri* and *Amphistegina vulgaris* in the Coralline Crag of Sudbourne. We have reason to believe that none of the three are proper to the Crag, but that all have been derived from earlier Tertiary beds; so also probably the *Alveolina, Peneroplis, Dendritina, Orbitolites*, and *Orbiculina* already described in the foregoing Parts I and II, and the *Orbitoides* that follows.

2. OPERCULINA AMMONOIDES (*Gronovius*), 1781. Plate VII, figs. 34 *a*, *b*.

NAUTILUS AMMONOIDES, *Gronovius*, 1781. Zooph. Gron., p. 282, No. 1220, and p. v (expl. Tab.).
— BALTHICUS, *Schroeter*, 1782. Naturforscher, vol. xvii, p. 120; and 1783, Einleitung, vol. i, p. 20, pl. i, fig. 2.
OPERCULINA COMPLANATA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 285, pl. xi, figs. 3, 4.
NONIONINA ELEGANS, *Williamson*, 1858. Rec. For. Gt. Br., p. 35, pl. iii, figs. 74, 75.
OPERCULINA AMMONOIDES, *P. and J.*, 1861. Ann. Mag. Nat. Hist., ser. 3, vol. viii, pp. 229, 230.
— — *Carpenter, Parker, and Jones*, 1862. Introd. Foram., pp. 252, 310.
NUMMULINA PERFORATA, var. (OPERCULINA) AMMONOIDES, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 398; pl. xiv, figs. 44 *a, b*; pl. xvii, figs. 62, 63.
NONIONINA ELEGANS, *Fischer*, 1870. Actes Soc. Linn. Bordeaux, vol. xxvii, p. 396 No. 45.
OPERCULINA AMMONOIDES, *B. and R.*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
— — *Vine*, 1878. Sci. Goss., vol. xiv, p. 52, fig. 31.
— — *Brady*, 1884. 'Challenger' Report, p. 745, pl. CXII, figs. 1 and 2.
— — — 1887. Journ. R. Micr. Soc., p. 926.
— — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, p. 434, pl. xx, figs, 38, 39. (Approaches our fig. 33, pl. v, in want of septal limbation.)
— — *A. Silvestri*, 1893. Mem. Pontif. Accad. N. Lincei, vol. ix, p. 217, pl. vi, fig. 5.
— — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 105, pl. xvii, figs. 833, 833 *a*, and 833 *a—c*. (In fig. 833 [*bis*] the septa are rather more curved, and the chambers fuller and thinner at edge, than in the type.)
ANOMALINA AMMONOIDES (?), *Woodward and Thomas*, 1895. Final Rep. Geol. Survey Minnesota, pl. D, fig. 30.

Characters.—Discoidal, compressed, compact; chambers fewer than in *Op. complanata*, and subquadrate; the limbation of the septa gives the surface a rotiform aspect.

Occurrence.—*Operculina ammonoides* has a wide geographical range, but is for the most part confined to comparatively shallow waters. It has been met with in the North Atlantic, including the Baltic, Gulf of Gascony, and Mediterranean; Gulf of Suez, off the Mauritius, Cape of Good Hope, and Australia; Malay Archipelago, the Philippines, Hong Kong, and south of Japan.

Fossil specimens have been recorded from the Pliocene of Calabria (Seguenza), and from the Pleistocene of Norway (Sars). In the Coralline Crag we have specimens from Broom Hill, zone **d**, Sutton and Gedgrave, zone **f**.

2*. OPERCULINA AMMONOIDES (*Gronovius*), 1781; var. CURVICAMERATA, nov., *Jones*.
Plate V, fig. 33.

This differs from *Op. ammonoides, vera*, in not having a septate limbation, in the narrowness and curvature of the chambers, and in its distinct margin. It is proposed to distinguish this as a variety under the name of *curvicamerata*. Probably from the Crag at Sutton.

Dr. A. Goës in 1894, 'Trans. Roy. Swed. Acad.,' figured a form intermediate to this and *Op. ammonoides* in his pl. xvii, figs. 833 *a*—*c*.

Genus 3.—NUMMULITES,[1] *Lamarck*, 1801.

The following are references to some of the most important memoirs treating of the history and particulars of this genus:

D'Archiac et Haime, 'Description des Animaux fossiles du Groupe Nummulitique de l'Inde,' livr. i, 1853; livr. ii, 1854.

Parker and Jones, 'Annals and Magazine of Natural History,' ser. 3, vol. v, 1860, pp. 106—111; pp. 289—294; vol. viii, 1861, pp. 230—238.

Carpenter, 'Introduction to the Study of Foraminifera,' Ray Soc., 1862, pp. 262—276.

Philippe de la Harpe, 'Bullet. Soc. Géol. France,' ser. 3, vol. v, 1877, pp. 817—835; 'Bullet. de la Société de Borda à Dax,' année iv, 1879, pp. 137—

[1] This name has priority over *Nummulina*, Lamarck. It was at first intended to distinguish fossil from living forms by making the names of the former end in *ites*, and those of the latter in *ina*. As fossil specimens were first recognised Lamarck named them *Nummulites;* d'Orbigny published some recent examples with the name *Nummulina*, but this is of use only as a synonym (see 'Catal. Foss. Foraminifera Brit. Mus.,' 1882, pp. 90, 91).

150; and in the 'Mém. Soc. Paléont. Suisse,' vol. vii, 1880, pp. 1—104; vol. viii, 1881, pp. 105—149; vol. x, 1883, pp. 141—180; and 'Palæontographica,' vol. xxx, 1883.

H. B. Brady, Report 'Challenger' Foram., 1884, pp. 747—749.

Synonyms:

Nummi lapidei,[1] *Mercati.*
Nummularius lapis, *Gesner.*
Nummalis lapis, *Brückmann, Fortis.*
Numismales lapides, &c., *Deluc, Scheuchzer, Clusius.*
Nummulus, *Stobæus, Bromell, Fortis.*
Numulus, *Lhuyd.*
Nummulaires, *Saussure.*
Porpitæ, *Stobæus.*
Salices, *Scheuchzer.*
Phacites, *Gesner, Blumenbach.*
Phacolites, *Sage.*
Phyllites, *Scheuchzer.*
HELICITES, *Gesner, Guettard, Burtin, Bosc, Defrance, Blainville.*
NAUTILUS, *Forskål, von Fichtel and von Moll.*
CAMERINA, *Bruguière, Bosc, Cuvier, Hericart de Thury.*
DISCOLITHUS, *Fortis.*
LENTICULITES, *Lamarck, von Schlotheim, Defrance, Blainville, Bronn, d'Archiac, Rütimeyer.*
LENTICULINA, *Lamarck, Defrance, Blainville, von Reuss.*
AMPHISTEGINA, *von Reuss, Carpenter.*
NUMULITES, LYCOPHRIS, ROTALITES, EGEON, *de Montfort.*
NUMMULARIA, *Sowerby, Parkinson, Carter, Brown, Dixon, Rütimeyer.*
NUMMULINA, *d'Orbigny, Risso, Sander Rang, Menke, Rouillier, Rütimeyer, d'Archiac, Ehrenberg, Savi, Meneghini, Lamarck, Boubée, Pusch, Martin, Carter, von Schlotheim, Michelotti, Joly, Leymerie, von Gümbel, Bornemann, Hoernes, Carpenter, Parker and Jones, Steinmann, Bronn, Schafhäutl, Seguenza, Karrer, Costa, Kaufmann, Buvignier, Galeotti, Mantell, Nicholson, Schauroth, Rouault, Brunner, Williamson, Cooke, Terquem, Deshayes, Brady, Römer, Potiez and Michaud, Heilprin, Macdonald, &c.*
NUMMULITES, *Defrance, Blainville, de Roissy, d'Orbigny, Lamarck, Alberti, Schafhäutl, De la Harpe, Kutorga, Conrad, Catullo, Leymerie, Joly, Emmons, d'Archiac and Haime, Bellardi, Gemmellaro, von Reuss, Carter, Rütimeyer, Meneghini, Parkinson, Crouch, Bronn, Mantell, Quenstedt, Fritel, Deshayes, Vutskits, Fraas, Brady, Morton, von Schlotheim, Sowerby, Ehrenberg, Prestwich, Parker and Jones, von Zittel, Abich, Michelotti, Heilprin, Pilla, Pictet, Medlicott and Blanford, Lartet, Tellini, Schlumberger, Parkinson,*

[1] Nature's money; also Saint Peter's, Saint Boniface's, and the devil's pence.

Blainville, Cuvier, Bütschli, Credner, Hartwig, Greene, Catullo, Boubée, Brunner, Cailliaud, Verbeek, Tchihatcheff, Uhlig, von Fritsch, Alth, Brown, Bowdich, Ure, Bakewell, Moxon, Ansted, Prevost, Lyell, Cornuel, von Hantken and Madaräsz, Brocklesby, Beudant, Hitchcock, Semper, Hahn, Neumayr, &c.

General Characters.—Shell free, lenticular or discoidal, spiral, equilateral, biconvex; convolutions numerous, embracing, the later usually hiding the preceding whorls by the extension of the alar flaps of its saddle-like chambers towards each umbilicus; segments numerous, short and narrow, with their lateral prolongations either *straight*, *curved*, *sinuous*, or *interlacing*; the latest chambers in matured shells contracted at their peripheral margin, so that they ultimately close in the shell; septal orifice single at the inner border of the septum.

1. Nummulites Boucheri, *De la Harpe*, 1879. Plate II, figs. 51, 52 (*Nummulina planulata*).

Part I, 1866 (*Nummulina planulata*), Appendix I, Table No. 93; Appendix II, Table No. 92.

Nummulites vasca, *Joly et Leymerie*, pars, *d'Archiac et Haime*, 1853. Foss. de l'Inde, p. 145, pl. ix, fig. 12.
Nummulina Germanica, pars, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Ges., vol. xii, p. 158, pl. vi, figs. 5—9.
Nummulites striatus (*d'Orb.*), *d'Arch.*, var., *Hantken*, 1875. Mittheil. Jahrb. kön. Ungar. Geol. Anstalt., vol. iv, p. 85, pl. xii, fig. 5.
— Boucheri, *De la Harpe*, 1879. Bullet. Soc. Borda à Dax, année iv, p. 146, pl. i, figs. iv, 1—10; vol. vi, pp. 240 and 243.
— — — 1883. Mém. Soc. Paléont. Suisse, vol. x, p. 179, pl. vii, figs. 33—59.
— — *Uhlig*, 1886. Jahrb. k. k. Geol. Reichsanst, vol. xxxvi, p. 205, pl. ii, figs. 7, 8, and 10 (var.); woodcuts (fig. 12), p. 206.

Characters.—A small lenticular Nummulite. Chambers relatively large, obliquely subquadrate; alar flaps rather broad, with strong septa, partially bent and slightly irregular, but giving a distinctly radiate pattern to the surface. This form belongs to the *radiate* group, and is thus related to *Nummulites striatus*, *variolarius*, *radiatus*, *Guettardi*, *Ramondi*, and others. Dr. Philippe de la Harpe's figures of *N. Boucheri* most resemble this Nummulite from the Crag. *N. Boucheri*

has been described as having a breadth of 2—3 mm. The Crag specimen here figured is 2·5 mm. broad and ·83 mm. thick.

The specimens of *Nummulites Boucheri* from Sudbourne are, there can be little doubt, " derived " from earlier beds, though in the absence of any positive indication it seems necessary to give it a provisional place in this Monograph.

Occurrence.—We have no record of the occurrence of this species in the recent condition. It occurs in the Eocene of Biarritz and in the Miocene or Oligocene at Magdeburg and in Hungary. So far as the Coralline Crag is concerned we have nothing to add to the record given in the First Part of the Monograph.

Sub-family 3.—Cycloclypeinæ.

Brady, '*Challenger*' *Report*, 1884, *p*. 76.

Complanate with thickened centre, or lenticular, consisting of a disc of chambers arranged in concentric annuli, with more or less lateral thickening of laminated shell-substance or acervuline layers of chamberlets. Septa double, and furnished with a system of interseptal canals.

Genus 1.—Orbitoides, *d'Orbigny*, 1847.

Carpenter, '*Introd. Study Foram.*,' 1862, *pp*. 298—304.

Discolithus, *Fortis.*
Lycophris, *Defrance, Sowerby, Carter.*
Lenticulina, *von Schlotheim.*
Asteriacites, *von Schlotheim.*
Nummulites, *Boubée.*
Orbitolites, *d'Archiac, Conrad, Michelin.*
Orbitulites, *Michelin, Bronn, Rütimeyer, Catullo, Rouault, Carter, von Gümbel.*
Orbitoides, *d'Orbigny, Carpenter, Carter, d'Archiac, Mayer, von Fritsch, Michelotti, Sowerby, Abich, Terquem, Ehrenberg, von Reuss, Kaufmann, Parker and Jones, Medlicott and Blanford, Bütschli, von Zittel, Carpenter, Morton, Seguenza, Karrer, von Gümbel, von Hantken, Jennings, Schwager, Martin, Brady, Stoliczka, Steinmann, and others.*
Calcarina, *d'Archiac, von Gümbel.*
Hymenocyclus, *Bronn, von Gümbel, Schafhäutl, von Schauroth, d'Eichwald.*
Cyclosiphon, *Ehrenberg.*
Asterodiscus, *Schafhäutl.*

DISCOCYCLINA, RHIPIDOCYCLINA, AKTINOCYCLINA, ASTEROCYCLINA, LEPIDOCYCLINA, *von Gümbel.*
NUMMULINA, *Bronn, Rütimeyer, d'Archiac.*
NUMISMALE, *Faujas de St. Fond.*
LENTICULITES, *von Schlotheim.*

General Characters.—Shell lenticular, consisting (firstly) of numerous chambers arranged in concentric annuli, in one plane round a central primordial chamber (large or small); and (secondly) of numerous layers of flattened chamberlets disposed more or less regularly on each face of this median plane.

1. ORBITOIDES ASPERA, *Gümbel*, 1868. Plate III, fig. 25 (*O. Faujasii*).

Part I, 1866 (*Orbitoides Faujasii*), Appendices I and II, Tables, No. 100.

ORBITOLITES SUBMEDIA (part), *d'Archiac*, 1846. Mém. Soc. Géol. France, ser. 2, vol. ii, mém. No. iv, pl. B (vi), figs. 6, 6 *a*. Named on the plate only. According to von Gümbel.
— PRATTI (part), *Michelin*, 1840–47. Iconograph. Zooph., p. 278, pl. lxiii, fig. 14. According to von Gümbel.
ORBITULITES CONVEXO-CONVEXA (?), *Catullo*, 1857. Terr. Sedim. Super. Venezia, p. 25, pl. i, fig. 7. According to von Gümbel.
ORBITOIDES (DISCOCYCLINA) ASPERA, *Gümbel*, 1868. Abhandl. k. Bayern. Akad. Wiss., vol. x, p. 698, pl. iii, figs. 13, 14, 32—34.
— ASPERA, *Hantken*, 1875 (1881). Mitth. Jahrb. k. Ung. Geol. Anst., vol. iv, p. 82, pl. xi, fig. 4.
— — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 77.
— — *Jones*, 1882. Catal. Foss. Foram. Brit. Mus., pp. 34, 41, 42.

Characters.—Lenticular, biconvex, surface very rough and warty; median chambers almost square in section. The Bavarian specimens range to 8 and 12 mm. in breadth. Our figured specimen is 4 mm. broad.

Occurrence.—The genus may be said to be characteristic of the Upper Cretaceous and of the Lower and Middle Tertiaries. Professor von Gümbel refers to this species as having been found at Hammer, Götzreuth, Kressenberg, and Schöneck in the Bavarian Alps; near Biarritz in South France; near Mosciano,

not far from Florence; at the Pretora Majella and the Consuma in the Apennines; and at Caldiero, Granella, and Brendola, not far from Verona. Our figured specimen is from Sudbourne; and, together with some others previously mentioned, pp. 364, 368, was probably derived from some older Tertiary strata.

INCERTÆ SEDIS. Plate III, figs. 23 and 24.

1. RADIOLARIAN? Plate III, figs. 23 *a*, 23 *b*.

The small orbicular fossil, Pl. III, figs. 23 *a*, 23 *b*, is of uncertain alliance. In 1862 the explanation of these figures was "hemispherical shell of an organism possibly allied to *Dactylopora*; a 'derived' fossil (?). Sutton."

As figured, it appears to be thick-shelled, perforate, and spherical, much like an *Orbulina*, but more like a *Cenosphæra*, a simple, lattice-shelled Radiolarian, common in both the recent and fossil condition. Where a piece of the outer shell had been broken away, the figure shows what seems like an internal mass with a few short pillar-like rods.

The specimen is unfortunately lost. Mr. S. V. Wood, who collected it, has left a memorandum to the effect that it was "hyaline," and possibly this may have had reference to a *siliceous* condition.

Mr. F. W. Millett has lent us a MS. book by Mr. S. V. Wood, written about 1845, containing notes and drawings of Foraminifera from the Crag, and in it this little fossil is sketched in outline, and thus described:

"1. ORBULINA PERFORATA, *mihi*.

"T[esta] orbicula[ris], sphærica, lævigata, perforata, perforationi[bu]s magnis, apertura—.

"Shell globular, spheroidal, smooth and hyaline; strong, with very large and regular perforations; aperture ——. Diameter $\frac{1}{40}$ of an inch [= 0·6 mm.]. *Locality*.—Coralline Crag, Gedgrave.

"I have only one specimen of this species, which I have ventured to place in this genus. It does not fully correspond in its generic characters, as the openings are few and very large, and as wide as the spaces between them. They stand in irregular quincunx, and are not more that eight in the half-circle [across the hemisphere]."

Thus, although the figures are referred to in the explanation of the Plate III (1866) as "hemispherical," one was evidently intended to represent a spherical

body; and, according to the measurements there given of the two magnified aspects of this little fossil, fig. 23 *a* × 50 gives 0·48 mm., and fig. 23 *b* × 8 gives only 0·35 mm.

Several published, small, spherical, more or less reticulate bodies, figured as *Orbulinæ*, which have a diameter of about 0·35 to 0·72 mm., and relatively large perforations, eight to eleven in number across the shell, might at first sight be referred to as analogues of this little organism, especially if the roughnesses on some of them were supposed to have been worn off. Compare—

(1) *Globulina porosa*, Terquem, 1858; *Orbulina porosa*, Brady, 1884; *O. porosa*, Haeusler, 1890; Terrigi, 1890; Egger, 1893. (2) *Orbulina liassica*, Terquem, 1862. (3) *Orbulina punctata*, Terquem, 1862; Terquem and Berthelin, 1874. (4) *Orbulina neojurensis*, Karrer, 1867; Terrigi, 1880; Uhlig, 1883. (5) *Orbulina millepora*, Terquem. (6) *O. macropora*, Terquem, 1876, 1883. (7) *O. Argoviensis*, Haeusler, 1881. (8) *Orbulina nitida*, Terquem, 1886.

Two of these in particular closely resemble our fig. 23 *a*, and are far more likely to be Radiolarian than Foraminiferal according to the figures and descriptions of them given by M. Terquem, thus:

Orbulina macropora, Terquem (from the Bajocian of the Moselle), 'Bulletin Soc. Géol. France,' ser. 3, vol. iv, 1876, p. 481, pl. xv, fig. 1: "Coquille blanchâtre, translucide, munie des pores très-grands et espacés; fort rare. Diamètre, 0·29 mm."

Orbulina nitida, Terquem (recent from Christiansand), 'Bulletin Soc. Zoolog. France,' vol. xi, 1886, p. 330, pl. xi, fig. 1: "Coquille subsphérique, lisse, brillante et transparente; fort rare. Diamètre, 0·31 mm."

The figure (Pl. III, 23 *a*) given in 1866 shows, however, that the little sphere is not hollow. Whether a Foraminiferal *Orbulina* or a Radiolarian *Cenosphæra*, perhaps it had been filled with matrix, some of which, entering small holes in the shell, still remains as short rods. If these little rod-like bodies had been more equally proportioned, we might look to the Radiolarian *Actinomma* (*Thecosphæra*) for an analogue. In this case the short pillar-like rods may have been the "beams" connecting the inner mass with the outer shell by passing into its substance at the narrow spaces between the round holes of the surface. Their relative positions, however, scarcely permit of this interpretation.

Our fossil is very much larger than the majority of Radiolaria. The perforations of the shell, however, are about the same in number as in some forms of *Ethmosphæra* and *Thecosphæra*, and are not relatively larger.

Of course we have here evidence only of analogy, and not identity. Supposing the little fossil to have been coated or thickened with mineral matter, and

if the structural analogy be true, we may see its Radiolarian nature beneath the mask.

Numerous minute, subglobular, pitted, white, calcareous organisms found in the Calcaire Grossier of Grignon, &c., belong to the Calciferous Algæ (*Siphoneæ verticillatæ*), being equivalent to the calcified segments of the jointed branches of *Cymopolia* (*Corallina*), &c. These and other Dactyloporoid débris were probably in the mind's eye when the Explanation of Plate III was written in 1866.

2. Dactyloporoid? Plate III, fig. 24.

This little hemispherical, subglobular (or beehive-shaped), reticulate body, shown obliquely, measures 0·3 mm. according to the magnified figure. Unfortunately it is lost.

It somewhat resembles the subconical and rounded ends of some forms of *Polytrypa*, *Dactyloporella*, *Haploporella*, and *Gyroporella*. Hence probably its presumed relationship to *Dactylopora* in the Explanation of Plate III (1866).

We may also note that, excepting in its relatively small size, it may be distantly compared with some *Polyzoa*, such as *Cerioporæ* and *Dianulites*.

TABLE OF THE DISTRIBUTION OF THE FORAMINIFERA IN THE CRAG AND SOME CONTEMPORANEOUS FORMATIONS IN EUROPE.

TABLE OF THE DISTRIBUTION OF THE FORAMINIFERA IN THE

By H. W. Burrows, A.R.I.B.A.,

vl. Very large. l. Large. m. Middle-sized. s. Small. rs. Rather small. vs. Very small.

	Genera, Species, and Varieties.	English — Coralline Crag. — Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
1	Biloculina ringens (*Lamarck*)	...	m. VR.	l. VR.	s. VR.	...	vl. RC.	m. RC.	s. VR.	vs. VR.
2	— elongata, *d'Orbigny*	...	vl. VR.	vl. VR.	...	...	...	vs. VR.	...	...
3	— depressa, *d'Orbigny*	...	...	s. R.	...	...	...	...	..	..
4	— *depressa*, var. *murrhyna*, Schwager	..	..		...		...	...	..	...
5	— *bulloides*, d'Orbigny	...	...	...	...	...	...	...	...	...
6	— bulloides, var. inornata, *d'Orb.*	...	s. VR.	...	...	s. R.	rs. VR.	...	...	vs. VR.
7	Spiroloculina planulata (*Lamarck*)	...	...	...	m. VR.	...	...	...	..	.
8	— excavata, *d'Orb.*	...	m. RC.	s. VR.	s. VR.	s. VR.	...	...	...	..
9	— canaliculata, *d'Orb*	...	m. R.	...	...	...	...	...		...
10	— dorsata, *Reuss*	s. VR.	m. C.	m. C.	m. VC.	s RR.	m. RR.	s. RR.	.	vs. C.
11	— nitida, *d'Orb.*	..		..	..	...	.	...		
12	— *grata*, Terquem		.	...	...		.	...		...
13	— *tenuimargo*, Brady						.	...		...
14	— *arenaria*, Brady	...	...	...	...	...	...	...	...	...
15	— — var. *perlonga*, de Amicis	...	...	...	...	...	...	...	..	...
16	Miliolina seminulum (*Linné*)	s. VR.	s. RC.	vs. VC.	s. VC.	m. C.	l. VC.	s. VC.	s. VR.	vs. VC.
17	— triangularis (*d'Orb.*)	...	...	...	...	...	...	...	...	...
18	— Cuvieriana (*d'Orb.*)	...	..	...	...	m. VR.	...	...	...	.
19	— tricarinata (*d'Orb.*)	...	...	...	...	...	...	...	...	...
20	— oblonga (*Montagu*)	s. R.	m. RC.	s. VC.	s. VC.	..	m. RC.	s. VC.	s. R.	vs. VC
21	— subrotunda (*Montagu*)	...	...	...	...	...	m. VR.	vs. VR.		...
22	— circularis (*Bornemann*)	...	..	...	s. VR.	..	...	...		.
23	— bicornis (*W. and J.*)	...	...	...	s. VR.	...	...	...	...	vs. VR.
24	— — (*M.*), var. Brongniartii (*d'O.*)	...		...	...	...	...	...	...	...
25	— pulchella (*d'Orb.*)	...	s. RR.	l. RR.	vs. VR.	...	...	vs. VR.	...	...
26	— Ferussacii (*d'Orb.*)	...	s. VR.	s. RR.	...	...	...	s. RR.	...	...
27	— *agglutinans* (d'Orb.)	...	...	...	...	...	...	...	...	...
28	— *Auberiana* (d'Orb.)	...	...	...	.	..	...	...	...	...
29	— *Linnæana* (d'Orb.)	...	..	...	...	...	...	..	...	...
30	— *reticulata* (d'Orb.)	...	...	...	...	...	...	...	...	...
31	— *sclerotica* (Karrer)	.	...	...	...		...	...	...	...
32	— *secans* (d'Orb.)	...	...	...	...	..	...	...	...	...
33	— *trigonula* (Lamarck)	...	...	...	...	...	...	...	...	...
34	— *undosa* (Karrer)	...	...	...	...	...	...	...	...	...
35	— *valvularis* (Reuss)	...	...	..	...		...	...	...	...
36	— *venusta*, Karrer	...	...	...	...	...	...	...	...	...
37	Sigmoilina tenuis (*Czjzek*)	...	...	...	...	s. VR.	...	...	...	...

CRAG AND IN SOME CONTEMPORANEOUS FORMATIONS IN EUROPE.

AND RICHARD HOLLAND.

VC. Very common. C. Common. RC. Rather common. R. Rare. RR. Rather rare. VR. Very rare.

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.		Upper Crag.						Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
vl. VC.	...	m. VR.	.	vs. R.	...	..	...	l. RC.	l. C.	RC.	×	..	..	1
...	...	m. VR	...	...	...	...	..	s. VR.	rs. VR.	VR.	×	s. VR.	..	2
m. C.	...	.	...	...	VR.	s. VR.	...	s. VR	s. VR.	R.	×	..	...	3
...	...		...	rs. VR.	...	...	...	.	.	..	...	...	..	4
	.	...	...	.	...	...	vs. VR.	vs. VR.	...		×	...	..	5
...	...		.	...	VR.		s. VR.	..	...	..	..	..		6
vl. C.	s. R.	...	...	...	...	...	.	.	...	VR.	...	...		7
.	.	...	...	vs. RR	...	...	...	m. VR.	m. VR.	VR.	...	rs. VR.	...	8
l. C.	..		..	...	..	...	...	s. VR.	s. VR.	...	×	.	...	9
...	..	..	...	s. RR.	...	m. RC.	rs. VR.	..	...	VR.	..	.	×	10
l. VR.	...			...	...	...	..	..	.	...	..	...	...	11
...	...	...	.	..	...	...	..	m. VR.	..	.	...	..		12
.	...	...	...	..		m. R.		...	...	...		...	...	13
..	..	...	...		...	...	...	.		VR.		.	...	14
...	...	...	...		...	...	...	...	...	VR.			...	15
vl. C.	s. VR.	×	..	l. C.	VR	vs. VR.	vs. RR.	rs. VC	rs. RR.	C.	×	...		16
l. C.	s. RC.	..	...	..		...	.	...	..	..	.		.	17
...	rs. R.	...	...	.	..	...	...	vs. VR.	...	..		rs. R.	..	18
vl. R.	...	..		vs. C.	...	...	...	...	rs. VR.	VR.		..	...	19
.	s. VR.			s. C.		...	rs. RC	s. VR.	...	VR.	...	vs. VR.	.	20
m. R.	...		.	vs. RR.		...	...	...	..	.	..		...	21
.	s VR.	...	.	rs. R.	.			...	...		...	.	...	22
...	...	...	...	vl. RC	..	...		s. VR.	rs. VR	VR.	...	rs. RR		23
LR.	...	...	...	...	. .	...		...	...	...	.	...	...	24
rl. VR	..	...	..	...	...	...	...	vl. VR.	vl. VC.	...	...	rs. R.	...	25
...	l. R.	...	..	rl. RC.	...	...	...	...	...	VR.	...	...	.	26
...	...	...	...	s. R.	...	...	...	...	...	VR.	...	...	...	27
...		...	...	...	VR.	...	...	...	...	VR.	...	...	...	28
...	...	...	...	...	...	...	...	...	rs. VR.	VR.	...	...	...	29
..	...	...	...	...	...	...	...	rs. VR.	rs. VR.	VR.	...	...	...	30
...	...	...	...	m. C.	...	...	...	..	...	...	...	...	...	31
...	...	...	...	s. VR.	..	...	...	...	...	...	...	...	...	32
...		...		s. RR.	...	...	.	...	...	...	×	...	...	33
...	...	...		s. R.	...	...	...	...	...	VR.	...	...	...	34
...	..	...	...	...	...	...	.	...	...	VR.	...	...		35
...	...	...	...	...	...	...	...	...	...	...	...	rs. VR.	...	36
...	s. VR.	...	...	...	R.	...	...	...	...	VR.	...	...	×	37

		English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
	Genera, Species, and Varieties.	Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
38	*Planispirina celata* (Costa)	...	...	...	...	...	...	...	...	...
39	Cornuspira foliacea (*Philippi*)	...	...	...	...	...	...	...	...	...
40	— involvens (*Reuss*)	...	...	l. VR.	...	...	vl. VR.	m. VR.	...	...
41	Peneroplis planatus (*F. & M.*)	...	...	s. VR.	...	...	...	...	...	...
42	— (Dendritina) arbuscula (*d'Orb.*)	...	...	...	...	...	...	...	...	...
43	— cylindraceus (*Lamarck*)	...	...	...	...	...	...	...	...	...
44	Orbiculina adunca (*F. & M.*)	...	...	...	...	vs. VR.	...	...	...	...
45	Orbitolites complanatus, *Lamarck*	...	...	...	...	...	...	...	...	...
46	Alveolina Boscii (*Defrance*) ?	...	...	...	...	...	...	...	...	...
47	*Pelosina apiculata*, Schrodt	...	...	...	...	...	...	...	...	...
48	*Psammosphæra fusca*, Schultze	...	...	...	...	...	...	...	...	...
49	*Saccammina sphærica*, Sars	...	...	...	...	...	...	...	...	...
50	*Rhabdammina irregularis*, Carpenter	...	...	...	...	...	...	...	...	...
51	Haplophragmium glomeratum (*Brady*)?	vs. VR.	s. RC.	s. RC.	s. VR.	...	...	...	s. C.	vs. VR.
52	— *Canariense* (d'Orb.)	...	...	...	...	...	...	...	...	...
53	— *Fornasinii*, De Amicis	...	...	...	...	...	...	...	...	...
54	*Haplostiche Soldanii* (Jones & Parker)	...	...	...	...	...	...	...	...	...
55	*Hippocrepina constricta*, Schrodt	...	...	...	...	...	...	...	...	...
56	Webbina hemisphærica, *J., P., & B.*	...	...	...	...	...	...	...	...	...
57	Textilaria sagittula, *Defrance*	s. RC.	m. VC.	rl. RC.	s. VC.	s. C.	l. VC.	s. RC.	s. RR.	vs. VC.
58	— — var. jugosa, *Brady*	s. VR.	l. VC.	rl. VR.	l. RC.	...	l. RC.	l. RR.	s. VR.	...
59	— sulcata, *Jones*	...	...	...	...	...	...	...	...	...
60	— subflabelliformis, *Hantken*	...	...	...	...	...	...	...	...	...
61	— agglutinans, *d'Orb.*	...	vl. C.	m. R.	s. VC.	m. C.	l. R.	s. RC.	m. RR.	vs. RC.
62	— — var. *porrecta*, Brady	...	...	...	...	...	...	...	...	...
63	— — var. densa, *Jones*	...	...	m. R.	...	...	...	...	...	...
64	— trochus, *d'Orb.*	vs. VR.	rl. VC.	m. R.	s. R.	n. VR.	...	...	m. RR.	vs. VR.
65	— conica, *d'Orb.*	s. RC.	m. C.	m. R.	s. R.	s. R.	...	s. RC.	s. RR.	vs. VR.
66	— gibbosa, *d'Orb.*	...	l. VC.	l. RC.	rl. RC.	m. C.	vl. VC.	l. RC.	m. VC.	...
67	— tuberosa, *d'Orb.*	...	...	...	...	...	...	...	...	...
68	— globulosa, *Ehrenberg*	...	...	...	...	...	...	...	...	...
69	— *abbreviata*, d'Orb	...	...	...	...	...	...	...	...	...
70	— *aciculata*, d'Orb.	...	...	...	...	...	...	...	...	...
71	— *aspera*, Ehr.	...	...	...	...	...	...	...	...	...
72	— *carinata*, d'Orb	...	...	...	...	...	...	...	...	...
73	— — var. *minor*, Seg	...	...	...	...	...	...	...	...	...
74	— *concava* (Karrer)	...	...	...	...	...	...	...	...	...
75	— *gramen*, d'Orb	...	...	...	...	...	...	...	...	...
76	— (*Bolivina ?*) *quadrilatera*, Schwager	...	...	...	...	...	...	...	...	...
77	*Verneuilina spinulosa*, Reuss	...	...	...	...	...	...	...	...	...
78	*Tritaxia lepida*, Brady	...	...	...	...	...	...	...	...	...
79	Bigenerina nodosaria, *d'Orb.*	...	...	...	...	...	...	...	...	...
80	— *capreolus*, d'Orb	...	...	...	...	...	...	...	...	...
81	Spiroplecta rosula, *Ehr.*[1]	...	...	...	...	...	...	...	...	vs. VR.
82	— *Americana*, Ehr.	...	...	...	...	...	...	...	...	...

[1] In the text (p. 160) this is said erroneously to occur in Zone **f.**

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Upper Crag.								Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	.	...	...	...	m. VR.	m. RC.	m. VR.	...	C.	...		×	38
vl. C.	.	.	...	s. R.	...	...	...	rl. VR.	s. VR.	.	..			39
l. C.	...	...	...	s. RC.	...	...	..	.	..	..	...			40
...	...	...		...	..	...	...	...	.	.		.		41
...	s. VR.	...	...	...	...	...	.	..	...					42
..	s. VR.	..	...	...	...	.	...	...	...		.		...	43
m. VR.	...	...	...		..	...	..	...	...				...	44
m. R.	...	...	...	...	..	...	...	...		.	..			45
...	m. VR		...	...		...	...	...	...	...	.			46
...	...	...		...	...	...	..	...	...		...		×	47
...	...	...	...	...	...	...	...	.	...	...	..		×	48
...	...	...	...	...	...	...	...	...	...	...	...		×	49
...	...		..	...	...	...	...	...	...				×	50
...	...	...	..	...	...	...	...	...	...	...	...	...	...	51
...	..	...	..	vs. VR.	...	...	...	...	...	...	...	...	..	52
...	...	...	...	...	...	...	...	..		VR.	...	.		53
...	...	...	...	...	..		...	...	l. RC	...	...	...		54
...	...		...	...	..	...	...	...	...	...	..		×	55
s. R.	...	...	..	...	...	...	...	...	...	...	...	...	.	56
m. C.	s. C.	m. RR.	...	m. RC.	...	rs. VR.	vs. VR.	s. VR.	rs. VR	VR.	...	s. VR.	×	57
...	...		.	...	..	...	m. VR.	rl. RC.	l. C.				.	58
s. VR.	.	..				...		..	..	.	..	.		59
s. VR.	...	...	...		.	..	...	...	...		...		.	60
vl. VC.	m. RC.		...		...		..	..	rs. VR.	.	×	rs. RC.	..	61
...	...	..		..	...	..	..	...	rl. VR.	...		...		62
...	..	...		..	...	.		...	..	...	..	...		63
l. C.	m. RR.	...			...	...	...	...	..	VR.	...	vs. R.	^	64
...	...	...	...	..	...	vs. VR.	s. VR.	s. VR.	m. VR.	VR.	...	vs. R.	...	65
vl. VC.	m. RC.	...		..	...	...		rs. VC.	rs. VR.	RC.	×	×	×	66
rl. VR.		...	...	...	...	...	...	...	...	RR.	...	...	.	67
..			s. VR.	rs. R.	...	...	...	...	...	...	...	..	...	68
...	...		..		...	...	..		...	RC.	×	...	×	69
...	...		...	..	...	...		..	...	RR.	...	...	..	70
...	...	..	..	...	...	...	...		...	VR.	..	...	...	71
...	.	...	..	...	C.	...	...		...	..	...	..	...	72
...		...	..	...	.	...	...			VR.		.	..	73
...	...	...	...	rs. VR.	...	...	...	...	...	VR.	...	...	...	74
...	...	...	...	rs. R.	...	...	s. RR.	...	m. C.	C.	...	..	...	75
...	..	...	...	m. VR.	...	...	...	...	...	...	...	...	...	76
..	..	...	...	m. R.	...	...	...	s. RR.	s. VR.	...	×	s. VR.	...	77
...	...	...	...	...	...	...	...	...	.	..	..	...	×	78
m. VR	...	.	...	vs. VR.	...	...	...	...	..	VR.	×	...	×	79
...	...	...	...	...	...	...	...	.	..		...	...	×	80
...	...	...	...	m. VR.	...	...	.	...	.	...	...	..		81
...	...	...	..	m. RC.	...	.	..	...	..	...	..	...	.	82

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tattingstone.	Sudbourne Hall.	Broom Hill.	Broom Hill.	Sutton.	Sutton.	Gedgrave.	Aldborough.	Gedgrave.
		1	2	3	4	5	6	7	8	9
83	*Gaudryina pupoides*, d'Orb.		...	...	...	...	...	...	...	
84	*Clavulina angularis*, d'Orb.		...	...	...		...	...	...	...
85	— *communis*, d'Orb.	...	...	...	...	...	...	...	...	...
86	— *cylindrica*, Hantken	...	...	...	...	...	...	...	...	...
87	— *gaudryinoides*, Fornasini	...	...	...	...	...	...	...	...	...
88	— *Parisiensis*, d'Orb.	...	...	...	...	...	...	...	...	...
89	— *rudis*, Costa	...	...	...	...	...	...	...	...	...
90	Bulimina elegans, *d'Orb.*	...	s. R.	s. VR.	...	...	...	vs. VR.	s. VR.	vs. VR.
91	— *elegans*, var. *exilis*, Brady	...	...	...	...	...		...	...	...
92	— aculeata, *d'Orb.*	...	...	...	...	...	...	...	...	vs. VR.
93	— marginata, *d'Orb.*	...		...	...	...			...	...
94	— *affinis*, d'Orb.	...	...	...	...		...	...	...	...
95	— *Buchiana*, d'Orb.	...		...	...	...	...	...	...	
96	— *elegantissima*, d'Orb		...	...	...	...		...	...	...
97	— *inflata*, Seguenza	...	...	...	...	...		...	...	
98	— *ovata*, d'Orb.	...		...	...	...	...	...	...	...
99	— *pyrula*, d'Orb.	...	...	...	...	...	...	...	...	...
100	— *pupoides*, d'Orb.	...	...	...	...	...	...	...	...	...
101	— *scabriuscula*, Reuss		...	...	...	...	...	...	...	...
102	— *subteres*, Brady	...	...	...	...	...	...	...	...	...
103	*Virgulina Schreibersiana*, Czjzek		...	...	...	...	...	...	...	...
104	— — var. obesa, *Jones*	...	vl. VR.	...	...	...	...	...	...	...
105	Bolivina punctata, *d'Orb.*	s. R.	rl. C.	rl. C.	...	...	s. RC.	vs. VR.	s. RC.	...
106	— Ænariensis (*Costa*)	s. C.	rl. C.	rl. C.	...	s. RC.	s. RC.	vs. VR.	s. RC.	s. RR.
107	— *Beyrichi*, Reuss	...	...	...	...	...	...	...	...	...
108	— — var. *alata*, Seguenza	...	...	...	...		...	...	...	...
109	— *dilatata*, Reuss	...		...	...	...	...	...	...	...
110	— *gibbera*, Millett	...	...	...			...	...	...	...
111	— *lævigata* (Williamson)	...		...	...	...	...	...	...	...
112	— *nobilis*, Hantken	...	...	...	...	...	...	...	...	...
113	— *obsoleta*, Eley	...	...	...	...	...	...	...	...	...
114	— *plicata*, d'Orb.	...	...	...	...	...	...	...	...	...
115	— *robusta*, Brady	...	...	...	...	...	...	...	...	...
116	— *textilarioides*, Reuss	...	...	...	...	...	...	...	...	...
117	— *tortuosa*, Brady	...	...	...	...	...	...	...	...	...
118	*Pleurostomella alternans*, Schwager	...	...	...	...	...	...	...	...	...
119	Cassidulina lævigata, *d'Orb.*	m. C.	...	l. RR.	...	s. RC.	m. C.	vs. RR.	vs. VR.	vs. VR
120	— crassa, *d'Orb.*	...	...	m. VR.	...	s. VR.	...	...	...	...
121	— — var. oblonga, *Reuss*	...	...	...	...	...	...	...	...	...
122	— *Bradyi*, Norman	...	...	...	...	...	...	...	...	...
123	Lagena globosa (*Montagu*)	m. VR.	m. C.	m. VR.	m. RR.	...	l. C.	m. RC.	s. VR.	vs. VR.
124	— apiculata, *Reuss*	...	...	...	...	...	...	s. VR.	...	...
125	— lævis (*Montagu*)	s. VR.	m. R.	s. VR.	s. VR.	s. VR.	m. VR.	s. VR.	s. VR.	s. VR.
126	— clavata (*d'Orb.*)	...	...	...	...	...	m. VR.	...	...	...
127	— gracillima, *Seguenza*	...	...	...	...	...	...	...	...	...

Sutton. 10	Sudbourne, Gedgrave, Aldborough, &c. 11	Red Crag. 12	Beds above Red Crag. 13	St. Erth Beds. 14	Diestian. 15	Casterlian. 16	Scaldisian. 17	Bordighera. 18	Albenga. 19	Trinité Victor. 20	Piedmont. 21	Monte Pellegrino, &c. 22	Garrucha (S. Spain). 23	
Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.		Upper Crag.						Plaisancian.				Astian.		
...	...	...	...	...	...	...	...	...	...	...	...	...	×	83
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	84
...	...	...	...	...	...	...	...	rl. R.	m. RC.	VC.		...	×	85
...	...	...	...	...	...	...	...	...	...	...	...	...	×	86
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	87
...	...	...	...	m. VR.	...	...	...	m. VR.	m. VR.	VR.		m. VR.	...	88
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	89
...	...	...	vs. R.	...	...	vs. VR.	vs. VR.	...	vs. VR.	...	...	...	...	90
...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	...	91
...	...	...	vs. VR.	rs. R.	...	...	...	...	...	...	×	...	×	92
...	s. R.	...	...	s. R.	...	...	...	...	...	...	...		...	93
...	...	...	...	m. RC.	...	...	...	s. VR.	vs. VR.	...	...		...	94
...	...	...	...	...	...	...	...	...	...	VR.	×	...	...	95
...	...	...	...	s. RR.	...	...	...	...	...		...	...	...	96
...	...	...	...	...	...	...	...	m. VR.	...	...	×	...	×	97
...	...	...	...	...	...	...	...	...	vs. VR.	VR.	...	...	...	98
...	...	...	...	...	...	...	...	s. VR.	...	VR.	×		×	99
...	...	...	...	m. RR.	...	...	...	...	...	...	×	...	×	100
...	...	...	...	...	R.	...	...	...	...	...	...	...	...	101
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	102
...	...	...	...	m. C.	C.	...	vs. VR.	...	vs. VR	...	...	...	...	103
...	...	...	...	...	...	...	...	...	...	...	...	...	...	104
...	s. R.	...	...	s. RC.	...	...	...	m. R.	s. VR.	VR.	×	...	×	105
...	...	...	...	...	...	s. RR.	s. RR.	s. VR.	rs. VR.	...	×	...	...	106
...	...	...	...	m. R.	...	...	...	...	...	...	×	...	×	107
...	...	...	...	...	...	...	...	m. R.	...	...	...	...	×	108
...	...	...	...	s. RC.	...	...	...	...	...		...	...	×	109
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	110
...	...	...	...	m. RC.	...	...	...	...	...		...	...	...	111
...	...	...	...	...	...	...	...	...	...	...	...	rs. VR.	...	112
...	...	...	...	m. VR.	...	...	...	...	...	...	...	...	...	113
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	114
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	×	115
...	...	...	...	s. R.	...	...	vs. VR.	...	...	...	...	...	...	116
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	117
...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	×	118
...	m. VR.	...	...	rs. VC.	...	...	vs. VR.	s. RR.	s. VR.	...	×	...	...	119
...	m. VR.	...	...	rs. RR.	...	vs. VR.	...	...	...	...	...	...	...	120
s. R.	m. VR.	...	...	rs. C.	...	...	...	...	...	...	...	...	×	121
...	...	...	...	rs. RC.	...	...	...	...	...	...	×	...	...	122
s. R.	l. RC.	...	...	rs. RC.	VR.	s. RR.	s. RR.	...	...	...	×	...	...	123
...	s. R.	...	...	s. RR.	...	...	...	...	...	VR.	...	...	...	124
m. VR.	...	...	...	rs. VC.	R.	vs. VR.	vs. VR.	...	...	...	×	...	×	125
...	...	...	...	m. RC.	VR.	...	...	...	...	...	...	...	×	126
vl. VR.	...	...	...	m. RC.	...	...	...	...	s. VR.	...	...	...	...	127

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
128	Lagena striata (*d'Orb.*)	...	...	m. VR.	m. VR	...	rl. VR.	s. VR.	...	s. VR.
129	— sulcata (*W. & J.*)	...	rl. C.	s. VR.	m. C.	...	s. R.	s. RC.	s. VR.	vs. VR.
130	— acuticosta, *Reuss*	...	l. VC.	l. VC.	m. VC.	s. RR.	rl. C.	m. VC.	l. RC.	vs. RC.
131	— gracilis, *Williamson*	s. VR.	...	...	...	...	...	...	...	...
132	— semistriata, *Will.*	...	...	...	...	...	...	s. VR.	...	...
133	— melo (*d'Orb.*)	s. RC.	rs. R.	s. VR.	s. VR.	s. RR.	s. VR.	s. VR.	...	vs. VR.
134	— hexagona (*Will.*)	...	...	s. VR.	...	s. VR.	s. VR.	s. VR.	...	...
135	— seminuda, *Brady*	...	...	m. VR.	...	s. R.	s. VC.	s. RR.	vs. VR.	vs. VR.
136	— reticulata (*Macgillivray*)	m. VR.	...	s. VR.	...	...	...	s. VR.	...	vs. RR.
137	— lævigata (*Reuss*)	m. VR.	...	m. R.	m. RR.	s. VR.	s. VR.	s. RR.	...	...
138	— quadrata (*Will.*)	m. VR.	vs. VR.	s. VR.	s. VR.	s. VR.	m. R.	s. VR.	...	vs. VR.
139	— marginata (*W. & J.*)	s. RR.	m. VC.	m. C.	s. VR.	s. VR.	m. RC.	s. VR.	s. C.	s. VC.
140	— — var. *inæquilateralis*, Wright	...	...	...	...	...	...	...	...	...
141	— seminiformis, *Schwager*	...	...	vs. VR.	...	...	...	...	...	...
142	— lagenoides (*Williamson*)	...	...	...	...	...	...	...	...	...
143	— formosa, *Schwager*	m. RR.	m. R.	rl. RR.	s. VR.	m. VR.	m. VR.	s. VR.	...	vs. VR.
144	— — var. comata, *Brady*	...	m. VR.	...	...	...	m. VR.	...	...	...
145	— annectens, *B. & H.*	m. VR.	...	...	...	...	...	...	...	...
146	— Orbignyana (*Seguenza*)	m. RR.	m. RR.	m. RC.	...	s. RR.	m. RR.	s. VR.	...	...
147	— lacunata, *B. & H*	m. RC.	rl. RR.	s. VR.	...	s. VR.	...	s. VR	...	s. VR.
148	— *acuta* (Reuss)	...	...	...	...	...	...	...	...	...
149	— *aspera*, Reuss	...	...	...	...	...	...	...	...	...
150	— *bicarinata* (Terquem)	...	...	...	...	...	...	...	...	...
151	— *clathrata*, Brady	...	...	...	...	...	...	...	...	...
152	— *Cornubiensis*, Millett	...	...	...	...	...	...	...	...	...
153	— *cymbæformis*, Millett	...	...	...	...	...	...	...	...	...
154	— *fimbriata*, Brady	...	...	...	...	...	...	...	...	...
155	— *hispida*, Reuss	...	...	...	...	...	...	...	...	...
156	— *lineata* (Will.)	...	...	...	...	...	...	...	...	...
157	— *longispina*, Brady	...	...	...	...	...	...	...	...	...
158	— *lucida* (Will.)	...	...	...	...	...	...	...	...	...
159	— *Lyellii* (Seguenza)	...	...	...	...	...	...	...	...	...
160	— *ornata* (Will.)	...	...	...	...	...	...	...	...	...
161	— *quadrata*, var. *semialata*, Balk. & Mill.	...	...	...	...	...	...	...	...	...
162	— *quadricostulata*, Reuss	...	...	...	...	...	...	...	...	...
163	— *rudis*, Reuss	...	...	...	...	...	...	...	...	...
164	— *squamosa* (Montagu)	...	...	...	...	...	...	...	...	...
165	— *Staphyllearia*, Schw.	...	...	...	...	...	...	...	...	...
166	— *sulcata*, var. *interrupta*, Will.	...	...	...	...	...	...	...	...	...
167	— *trigono-marginata*, P. & J.	...	...	...	...	...	...	...	...	...
168	— *trigono-oblonga*, Seg. & Sid.	...	...	...	...	...	...	...	...	...
169	— *Yokoyamæ*, Millett	...	...	...	...	...	...	...	...	...
170	Glaudulina lævigata, *d'Orb.*	...	...	...	...	...	...	...	...	...
171	— *rotundata*, Reuss	...	...	...	...	...	...	...	...	...
172	Nodosaria ambigua, *Neugeboren*	...	s. VR.	...	...	...	...	...	...	...

Pliocene. Zones undetermined. Sutton.	Pliocene. Zones undetermined. Sudbourne, Gedgrave, Aldborough, &c.	Pliocene. Upper Crag. Red Crag.	Pliocene. Upper Crag. Beds above Red Crag.	Pliocene. St. Erth Beds.	Belgian Pliocene. Diestian.	Belgian Pliocene. Casterlian.	Belgian Pliocene. Scaldisian.	Italian Pliocene. Plaisancian. Bordighera.	Italian Pliocene. Plaisancian. Albenga.	Italian Pliocene. Plaisancian. Trinité Victor.	Italian Pliocene. Plaisancian. Piedmont.	Italian Pliocene. Astian. Monte Pellegrino, &c.	Spanish Pliocene. Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	m. VR.	...	...	m. VC.	C.	...	...	...	...	...	×	...	...	128
vl. C.	l. RC.	m. VR.	s. R.	s. RR.	R.	...	s. VR.	...	s. VR.	...	×	...	×	129
...	...	...	...	...	...	s. RR.	m. RR.	...		...	...	...	...	130
...	...	...	...	...	...	...	...	...	...	...	...	...	...	131
s. R.	...	...	...	s. RR.	C.	...	...		...	...	...	...	...	132
...	m. R.	...	...	s. VR.	...	s. VR.	s. VR.	...	...		...		...	133
...	...	...	...	m. RC.	...	...	s. VR.	...	...	...	×	...	×	134
...	...	...	...	rs. R.	...	...	s. VR.	...	...		...	...	...	135
...		...	...	...	VR.	...	s. VR.	s. VR.	...	...	...			136
...	...	...	...	l. C.	...	s. VR.	s. VR.	...	...	...	...	...	...	137
...	...	...	...	m. C.	...	vs. VR.	vs. VR.	...	...	...	...	...	...	138
s. VR.	m. RC.	m. VR.	...	s. RC.	...	vs. VR.	vs. VR.	vs. VR.	...	...	...	...		139
...	...	...	...	m. RR	...	...	...	...	...	...	...	...	...	140
...	...	...	...	s. VR,	...	...	...		...	...		...	...	141
m. VR.	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	142
...	...	...	...	...	...	l. VR.	l. C.	...	...	...		...	...	143
...	...	...	...	...	...		m. VR.		...	...	...	...		144
...	...	...	...	...	...	m. VR.	...	...	...	...	...	...	...	145
...	...	...	...	m. C.	...	...	s. RC.	...	vs. VR.	...	×	...	...	146
...	...	...	...	...	...	s. VR	s. RC.	...	...	...	...	...	...	147
...	...	...	...	s. RC.	...	...	...	...			...		...	148
...	...	...	...	...	...	...	...	...				...	×	149
...	...	...	...	m. VR.	...	...	...	...	...		...	...	...	150
...	...	...	...	...	...	...	s. VC.	...	...	...			...	151
...	...	...	...	m. R	...	...	...	...	...	...	...	...	...	152
...	...	...	...	vs. RC	...	...		...	...		...	...	...	153
...	...	...	...	vs. RR.	...	...	...	...	...			...		154
...	...	...	...	...	...	...	...	...	...	...	×	...	×	155
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	156
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	157
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	158
...	...	...	...	m. VR.	...	...	...	...	...	...	...	...	...	159
...	...	...	...	l. VR.	...	...	...	...	...	...	...	...	...	160
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	161
...	...	...	...	rs. C.	...	...	...	...	...	...	...	...	...	162
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	163
...	...	...	...	m. VC.	...	s. VR	...	...	...	...	...	...	...	164
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	165
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	166
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	167
...	...	...	...	m. RR.	...	...	...	...	...	...	...	...	...	168
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	169
l. RC.	...	...	...	vs. R.	VR.	...	...	m. VR.	rl. VR.	VR.	...	...	×	170
...	...	...	...	...	× ?	...	...	...	...	...	...	...	...	171
s. VR.	...	...	...	...	...	...	...	...	...	VR.	...	...	...	172

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zion **f.**		Zone **g.**	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
173	Nodosaria raphanus (*Linné*)	...	s. R.	s. VR.	...	...	...	...	...	...
174	— raphanistrum (*Linné*)	...	...	...	...	...	...	...	...	...
175	— proxima, *Silvestri*	..	s. VR.	s. VR.	...	..	s. VR.	s. VR.	...	vs. VR.
176	— (Dentalina) obliqua (*Linné*)	...	...	s. VR.	...	...	vl. VR.	...	s. VR.	...
177	— — obliquestriata, *Reuss*	...	...	...	...	..	...	...	...	...
178	— — pauperata, *d'Orb.*	...	...	...	...	...	vl. R.	...	...	...
179	— *acuminata*, Hantken	...	...	...	...	...	...	...	...	..
180	— (*Dentalina*) *Adolphina*, d'Orb.	...	...	...	...	...	...	...	...	...
181	— *æqualis*, Reuss	...	...	...	...	..	...	...	...	...
182	— *bacillum*, Defrance	...	...	...	...	...	...	...	...	...
183	— (*Dentalina*) *brevis*, d'Orb.	...	..	...	...	...	...	...	...	...
184	— *calomorpha*, Reuss	...	...	...	...	...	...	...	...	...
185	— (*Dentalina*) *catenulata*, Brady	...	...	...	...	...	...	...	...	...
186	— — *communis*, d'Orb.	...	...	...	...	...	...	...	...	...
187	— — *consobrina*, d'Orb.	...	...	...	...	...	...	...	...	...
188	— — *costulata*, Reuss	...	...	..	...	...	...	...	...	...
189	— *elegantissima*, Hantken	...	...	...	...	...	...	...	...	...
190	— *farcimen*, Reuss, after Soldani	...	...	...	...	...	...	...	...	...
191	— *filiformis*, d'Orb.	...	...	...	...	...	...	...	...	...
192	— (*Dentalina*) *guttifera*, d'Orb.	...	...	...	...	...	...	...	...	...
193	— *hispida*, d'Orb.	...	...	...	...	...	...	...	...	...
194	— — var. *sublineata*, Brady	...	...	...	...	...	...	...	...	...
195	— *longiscata*, d'Orb.	...	...	...	...	...	...	...	...	...
196	— (*Dentalina*) *mucronata*, Neugeboren	...	...	...	...	...	...	...	...	...
197	— *perversa*, Schwager	...	...	...	...	...	...	...	...	...
198	— *pirula*, d'Orb.	...	...	...	...	...	...	...	...	...
199	— *plebeia* (Reuss)	...	...	...	...	...	...	...	...	...
200	— *radicula* (Linné)	...	...	...	...	...	...	...	...	...
201	— *rudis*, d'Orb.	...	...	...	...	...	...	...	...	...
202	— *scabra*, de Amicis	...	...	...	...	...	...	...	...	...
203	— *scalaris* (Batsch)	...	...	...	...	...	...	...	...	...
204	— *simplex*, Silvestri	...	...	...	...	...	...	...	...	...
205	— *soluta*, Reuss	...	...	...	...	...	...	...	...	...
206	— *subtertenuata*, Schwager	...	...	...	...	...	...	...	...	...
207	— (*Dentalina*) *subtilis*, Neugeboren	...	...	...	...	...	...	...	...	...
208	— *verruculosa*, Neugeboren	...	...	...	...	...	...	...	...	...
209	— (*Dentalina*) *vertebralis* (Batsch)	...	...	...	...	...	...	...	...	...
210	*Lingulina alata*, Schrodt	...	...	...	...	...	...	...	...	...
211	— *carinata*, d'Orb.	...	...	...	...	...	...	...	...	...
212	— *costata*, d'Orb.	...	...	...	...	...	...	...	...	...
213	*Frondicularia alata*, d'Orb.	...	...	...	...	...	...	...	...	...
214	— *annularis*, d'Orb.	...	...	...	...	...	...	...	...	...
215	— *Dumontana*, Reuss	...	...	...	...	...	...	...	...	...
216	— *Guestphalica*, Reuss	...	...	...	...	...	...	...	...	...
217	— *Hosiusi*, Reuss	...	...	...	...	...	...	...	...	...

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
		Upper Crag.												
Zones undetermined.								Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
s. R.	...	...	s. R.	...	...	...	...	rs. RC.	...	R.	×	×	...	173
s. R.	...	...	...	...	...	vs. VR.	...	vl. RR.	vl. VR.	RC.	×	×	...	174
...	...	...	...	...	...	vs. VR.	s. VR.	s. VR.	s. VR.	...	...	...	...	175
l. C.	...	...	...	...	VC.	...	...	...	m. RR	RC.	...	×	×	176
l. R.	...	...	...	...	...	rl. VR.	...	...	...	...	...	...	...	177
l. C.	...	...	...	rs. R.	...	...	...	...	...	VR.	×	...	×	178
...	...	...	...	...	...	...	...	...	...	...	...	...	×	179
...	...	...	...	...	...	...	...	...	s. RR.	...	...	...	...	180
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	181
...	...	...	...	...	...	...	...	...	...	...	...	...	×	182
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	183
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	184
...	...	...	...	...	...	...	...	...	rl. VR	VR.	...	...	×	185
...	...	...	...	...	...	...	...	rs. VR.	...	R.	×	...	×	186
...	...	...	...	...	...	vs. VR.	...	rl. RC.	s. VR.	RR.	...	...	×	187
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	188
...	...	...	...	...	...	...	...	...	...	...	×	...	×	189
...	...	...	...	...	VR.	...	...	...	...	VR.	...	...	...	190
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	191
...	...	...	...	m. RR.	...	...	...	...	...	...	×	...	...	192
...	...	...	...	...	...	...	...	m. VR.	m. RR.	RR	×	...	×	193
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	194
...	...	...	...	...	...	...	...	rl. RR.	rl. C.	VR.	...	...	...	195
...	...	...	...	...	...	...	...	...	...	...	...	...	×	196
...	...	...	...	...	...	...	...	...	...	RR.	...	...	...	197
...	...	...	...	m. RC.	...	...	...	...	...	...	×	...	...	198
...	...	...	...	...	...	...	...	...	...	...	...	...	×	199
...	...	...	...	rs. R.	...	...	...	...	...	RR.	×	×	×	200
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	201
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	202
s. VR.	s. VR	...	...	s. R.	VR.	...	...	rl. VC	rs. R.	VC.	×	...	×	203
...	...	...	...	m. C.	...	...	...	...	...	...	...	...	...	204
...	...	...	...	...	...	vs. VR.	...	vs. VR.	vl. VR.	...	...	...	×	205
...	...	...	...	...	...	...	...	...	...	...	...	...	×	206
...	...	...	...	...	...	...	...	...	...	...	...	...	×	207
...	...	...	...	...	...	...	...	...	...	...	...	...	×	208
...	...	...	...	...	...	...	...	l. RR.	...	RR.	...	...	×	209
...	...	...	...	...	...	...	...	...	...	...	...	...	×	210
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	211
...	...	...	...	...	...	...	...	...	...	VR.	×	...	×	212
...	...	...	...	...	...	...	...	...	...	...	...	×	×	213
...	...	...	...	...	...	...	...	...	vl. VR	...	...	...	...	214
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	215
...	...	...	...	...	...	...	...	m. R.	s. VR.	...	...	...	...	216
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	217

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
218	*Frondicularia inæqualis*, Costa	...	...	...	...	...	...	...	...	...
219	— *interrupta*, Costa	...	...	...	...	...	...	...	...	...
220	— *Nysti*, Reuss	...	...	...	...	...	...	...	...	...
221	Vaginulina lævigata, *Roemer*	...	...	...	...	...	...	...	...	...
222	— linearis (*Montagu*)	...	...	...	...	...	...	...	...	...
223	— obliquestriata, *Jones*	...	..	...	...	...	...	...	...	...
224	— *cymba* (d'Orb.)	...	...	...	...	...	...	...	...	...
225	— *legumen* (Linné)	...	...	...	...	...	...	...	...	...
226	— *margaritifera* (Batsch)	...	...	...	...	...	...	...	...	...
227	Rhabdogonium tricarinatum (*d'Orb.*)	s. VC.	m. C.	m. VC.	...	s. RC.	m. VC.	s. RR.	s. VR.	vs. RC.
228	Marginulina glabra, *d'Orb.*	...	...	...	...	...	...	...	...	...
229	— costata (*Batsch*)	...	...	s. VR.	...	...	...	...	...	...
230	— *hirsuta*, d'Orb.	.	...	...	...	...	...	...	...	.
231	— *striatissima*, Schrodt	...	...	...	...	...	...	...	...	..
232	Cristellaria cultrata (*Montfort*)	...	...	...	...	...	s. VR.	...	...	...
233	— gibba, *d'Orb.*	...	...	...	...	...	m. RR.	...	...	vs. VR.
234	— reniformis, *d'Orb.*	...	...	s. VR.	...	...	l. VR.	...	...	...
235	— *aculeata*, d'Orb.	...	...	...	...	...	...	...	...	...
236	— *acutauricularis* (F. & M.)	...	...	...	...	...	...	...	...	...
237	— *Ariminensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
238	— *calcar* (Linné)	...	...	...	...	...	...	...	...	...
239	— *cassis* (F. & M.)	...	...	...	...	...	...	...	...	...
240	— *confusa*, Seguenza	...	...	...	...	...	...	...	...	...
241	— *convergens*, Bornemann	...	...	...	...	...	...	...	...	...
242	— *costata* (F. & M.)	...	...	...	...	...	...	...	...	...
243	— *crassa*, d'Orb.	...	...	...	...	...	..	...	...	...
244	— *crepidula* (F. & M.)	..	...	...	...	..	..	...	...	...
245	— *dentata*, Karrer	...	...	...	...	...	...	...	...	...
246	— *echinata* (d'Orb.)	...	...	...	...	...	...	...	...	...
247	— *elongata*, Montfort	...	...	...	...	...	...	...	...	...
248	— *inornata*, d'Orb.	...	...	...	...	...	...	...	...	...
249	— *Italica* (Defrance)	...	...	...	...	...	..	...	...	...
250	— *latifrons*, Brady	...	...	...	...	...	...	...	...	...
251	— *mammiligera*, Karrer	...	...	...	...	...	...	...	...	...
252	— *nitida*, d'Orb	...	...	...	...	...	...	...	...	...
253	— *orbicularis* (d'Orb.)	...	...	...	...	...	...	...	...	...
254	— *rotulata* (Lamarck)	...	...	...	...	...	...	...	...	...
255	— *semi-impressa*, Reuss	...	...	...	...	...	...	...	...	...
256	— *tangentialis*, Reuss	...	...	...	...	...	...	...	...	...
257	— *tricarinella*, Reuss	...	...	...	...	...	...	...	...	...
258	— *variabilis*, Reuss	...	...	...	...	.	...	...	...	...
259	— *vortex* (F. & M.)	...	...	...	...	...	...	...	...	..
260	Polymorphina lactea (*W. & J.*)	s. VR.	rl. RC.	rl. RC.	m. VC.	m. RR	l. RC.	m. RC.	s. R.	vs. VC.
261	— — &c. (fistulose)	s. VR.	l. R.	vl. RR.	m. R.	...	vl. RR.	...	m. VR.	...
262	— gibba, *d'Orb.*	rl. C.	l. C.	l. VC.	rl. VC.	rl. C.	vl. VC.	m. RR.	s. RC.	...

Pliocene. Zones undetermined. Sutton. 10	Pliocene. Zones undetermined. Sudbourne, Gedgrave, Aldborough, &c. 11	Upper Crag. Red Crag. 12	Upper Crag. Beds above Red Crag. 13	St. Erth Beds. 14	Belgian Pliocene. Diestian. 15	Belgian Pliocene. Casterlian. 16	Belgian Pliocene. Scaldisian. 17	Italian Pliocene. Plaisancian. Bordighera. 18	Italian Pliocene. Plaisancian. Albenga. 19	Italian Pliocene. Plaisancian. Trinité Victor. 20	Italian Pliocene. Plaisancian. Piedmont. 21	Italian Pliocene. Astian. Monte Pellegrino, &c. 22	Spanish Pliocene. Garrucha (S. Spain). 23	
...	...	...	...	...	...	...	...	m. VR	...	...	×	...	...	218
...	...	...	...	...	...	...	...	...	...	...	...	...	×	219
...	...	...	...	...	R.	...	...	...	...	...	...	...	...	220
...	l. VR.	...	...	...	...	...	...	...	...	...	...	...	...	221
l. VR.	...	...	...	...	...	...	...	...	...	VR.	...	...	×	222
m. VR.	...	...	...	...	...	...	...	...	...	...	...	...	...	223
...	...	...	...	...	...	...	...	...	...	...	...	...	×	224
...	...	...	...	...	...	...	...	...	m. VR.	RC.	×	...	×	225
...	...	...	...	...	...	...	...	...	...	...	...	...	×	226
...	...	...	...	s. C.	...	s. RR.	s. VR.	m. R.	s. VR.	VR.	...	...	×	227
s. VR.	...	...	...	...	...	...	...	m. RR.	...	R.	×	...	×	228
m. R.	...	...	...	...	...	...	...	vl. VC.	vl. VC.	VC.	...	...	×	229
...	...	...	...	...	...	...	...	...	...	VR.	...	...	×	230
...	...	...	...	...	...	...	...	...	...	...	...	...	×	231
m. VR.	...	...	s. VR.	...	...	...	...	l. C.	rl. RR.	VC.	...	...	×	232
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	233
...	...	...	...	...	...	...	...	...	...	...	...	...	×	234
...	...	...	...	...	...	...	...	...	...	...	...	...	×	235
...	...	...	...	...	...	...	...	...	...	VR.	×	...	...	236
...	...	...	...	...	...	...	...	...	l. VR.	...	×	...	×	237
...	...	...	...	...	...	vs. VR.	...	rl. C.	l. VC.	VC.	×	×	×	238
...	...	...	...	...	...	...	...	vl. R.	vl. RR.	RC.	×	×	×	239
...	...	...	...	...	...	...	...	...	...	...	×	...	...	240
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	241
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	242
...	...	...	...	...	...	...	...	...	...	VR.	...	...	×	243
...	...	...	...	s. RR.	...	...	...	...	...	...	×	...	×	244
...	...	...	...	...	...	...	...	...	...	...	...	...	×	245
...	...	...	...	...	...	...	...	rl. R.	...	RC.	...	...	×	246
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	247
...	...	...	...	...	...	...	...	...	...	...	...	...	×	248
...	...	...	...	...	...	...	...	rs. VR.	...	RR.	...	...	×	249
...	...	...	...	...	VR.	...	...	rs. VR.	...	...	×	...	...	250
...	...	...	...	...	...	...	...	...	...	...	...	...	×	251
...	...	...	...	...	...	...	...	...	...	R.	...	...	...	252
...	...	...	...	...	...	...	...	...	...	RC.	...	...	×	253
...	...	...	...	s. RR.	...	...	...	m. RC.	rl. RR.	VC.	...	...	×	254
...	...	...	...	...	...	...	...	...	...	...	×	...	...	255
...	...	...	...	...	...	...	...	...	...	...	...	...	×	256
...	...	...	...	...	...	...	...	...	...	...	...	...	×	257
...	...	...	...	...	...	...	...	s. VR.	...	...	×	...	...	258
...	...	...	...	...	...	...	...	...	...	RR.	...	...	×	259
vl. VC.	l. C.	×	s. R.	s. R.	...	rs. VC.	s. RR.	...	...	...	...	...	...	260
vl. VC.	m. RC.	...	...	s. VR.	...	...	...	...	...	...	...	...	...	261
vl. VC.	m. RC.	s. VR.	...	rs. R.	VR.	rs. VR.	rs. VR.	...	...	VR.	×	...	×	262

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
263	Polymorphina gutta, *d'Orb.*	...	...	...	...	...	...	...	...	...
264	— sororia, *Reuss*	...	...	m. VR.	...	...	...	m. VR.	rl. VR.	...
265	— compressa, *d'Orb.*	rl. C.	l. R.	vl. C.	l. VC.	...	vl. VC.	m. RR.	m. R.	...
266	— Thouini, *d'Orb.*	...	l. VR.	m. R.	m. VR.	...	...	...	...	...
267	— nodosaria, *Reuss*	...	...	...	...	...	vl. R.	...	...	...
268	— cylindroides, *Roemer*	...	...	...	rl. RR.	...	...	rl. VR.	...	...
269	— concava, *Williamson*	...	...	...	...	...	...	vs. VR.	...	...
270	— communis, *d'Orb.*	rl. C.	m. C.	l. VC.	m. C.	m. RR.	vl. VC.	m. C.	s. VR.	vs. VC.
271	— problema, *d'Orb.*	...	rl. VR.	vl. RR.	...	...	vl. VC	m. RR.	...	...
272	— turgida, *Reuss*	...	...	...	...	...	...	...	...	...
273	— complanata, *d'Orb.*	s. R.	l. RC.	m. C.	...	m. C.	vl. C.	l. C.	m. C.	vs. R.
274	— frondiformis, *S. V. Wood*	m. R.	vl. C.	m. VC.	m. C.	...	vl. VC.	m. RC.	m. C.	...
275	— — var. brevis, *Jones*	...	...	...	...	...	...	s. VR.	...	...
276	— — var. lineata, *Jones*	...	...	...	...	...	...	...	...	...
277	— variata, *J., P., & B.*	m. VR.	l. C.	m. RC.	m. R.	m. R.	vl. VC.	rl. VC.	m. VC.	...
278	— tuberculata, *d'Orb*	...	m. R.	rl. VR.	...	...	...	...	...	...
279	— hirsuta, *B., P., & J.*	...	m. RC.	rl. VR.	m. VR.	s. VR.	m. RC.	m. RC.	...	...
280	— rugosa, *d'Orb.*	...	...	...	...	...	...	...	...	...
281	— *acuta*, Römer	...	...	...	...	...	...	...	...	...
282	— *æqualis*, d'Orb.	...	...	...	...	...	...	...	...	...
283	— *amygdaloides*, Reuss	...	...	...	...	...	...	...	...	...
284	— *angusta*, Egger	...	...	...	...	...	...	...	...	...
285	— *decora*, Reuss	...	...	...	...	...	...	...	...	...
286	— *fusiformis*, Roemer	...	...	...	...	...	...	...	...	...
287	— *inæqualis*, d'Orb.	...	...	...	...	...	...	...	...	...
288	— *lanceolata*, Reuss	...	...	...	...	...	...	...	...	...
289	— *minuta*, Reuss	...	...	...	...	...	...	...	...	...
290	— *oblonga*, d'Orb.	...	...	...	...	...	...	...	...	...
291	— *proteiformis*, Reuss	...	...	...	...	...	...	...	...	...
292	— *regina*, B., P., & J.	...	...	...	...	...	...	s. VR.	...	...
293	— *regularis*, Münst.	...	...	...	...	...	...	...	...	...
294	— — var. *parallela*, Millett	...	...	...	...	...	...	...	...	...
295	— *spinosa*, d'Orb.	...	...	...	...	...	...	...	...	...
296	— *subnodosa*, Reuss	...	...	...	...	...	...	...	...	...
297	Dimorphina tuberosa, *d'Orb.*	...	...	...	...	...	l. VR.	...	...	...
298	— compacta, *B., P., & J.*	...	...	...	...	...	...	vs. VR.	...	...
299	Uvigerina angulosa, *Will.*	s. RR.	s. RR.	m. R.	...	vs. VR.	vs. VR.	...	s. VR.	...
300	— Canariensis, *d'Orb.*	...	...	...	s. VR.	vs. R.	...	...	...	...
301	— — var. farinosa, *Hantken*	s. VR.	...	...	...	...	...	...	...	...
302	— *aculeata*, d'Orb.	...	...	...	...	...	...	...	...	...
303	— *asperula*, Czjzek	...	...	...	...	...	...	...	...	...
304	— *pygmæa*, d'Orb.	...	...	...	...	...	...	...	...	...
305	*Sagrina columellaris*, Brady	...	...	...	...	...	...	...	...	...
306	— *nodosa*, P. & J.	...	...	...	...	...	...	...	...	...
307	— *striata*, Schwager	...	...	...	...	...	...	...	...	...

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.		Upper Crag.						Plaisancian.				Astian.		
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
vl. VC.	l. VC.	...	...	...	...	...	...	...	...	...	...	...	...	263
...	...	...	...	rs. VR.	C.	...	...	...	...	...	...	...	...	264
vl. VC.	l. VC.	...	s. VC.	m. C.	VR.	...	...	...	...	...	...	..	...	265
l. C.	m. RC.	...	...	...	...	...	...	...	...	...	...	...	...	266
...	...	...	...	...	×	...	...	...	...	...	...	...	...	267
...	...	...	...	...	...	...	...	...	...	...	...	...	...	268
...	vs. VR.	...	...	m. VR.	...	m. VR.	...	...	...	...	...	...	...	269
...	...	...	...	s. VR.	...	rl. VR.	vs. VR.	rl. R.	s. VR.	...	...	s. VR.	×	270
m. VR.	...	...	...	...	VR.	...	...	...	...	...	...	...	...	271
m. VR.	...	...	...	...	...	...	...	...	...	...	...	...	...	272
vl. VC.	l. C.	×	...	rs. VR.	...	rl. RC.	vs. VR.	s. VR.	...	...	...	...	...	273
vl. VC.	...	...	...	...	...	...	...	...	...	...	...	...	...	274
...	...	...	...	...	...	...	...	...	...	...	...	...	...	275
...	s. VR.	...	...	...	...	...	...	...	...	...	...	...	...	276
l. R.	...	...	...	...	...	...	...	...	...	...	...	...	...	277
vs. VR.	...	...	m. VR.	...	...	s. VR.	...	...	...	...	...	...	...	278
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	279
m. RR.	...	...	...	...	...	...	...	...	...	...	...	...	...	280
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	281
...	...	...	...	m. VR.	VR.	...	...	...	...	...	...	...	...	282
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	283
...	...	...	...	m. R.	...	...	s. VR.	...	...	...	...	...	...	284
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	285
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	286
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	287
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	288
...	...	...	...	...	R.	...	...	...	...	...	...	...	...	289
...	...	...	...	...	...	m. VR.	...	...	...	...	...	...	...	290
...	...	...	...	...	C.	...	...	...	...	...	...	...	...	291
...	...	...	...	rs. RR.	...	...	...	...	...	...	...	...	...	292
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	293
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	294
...	...	...	...	...	...	...	...	m. R.	...	...	...	...	...	295
...	...	...	...	...	VR.	...	...	...	...	...	...	...	...	296
l. R.	...	...	...	...	...	vs. VR.	...	...	...	...	...	...	×	297
l. R.	...	...	...	rs. R.	...	...	...	...	...	...	...	...	...	298
...	...	...	...	s. RC.	...	vs. VR.	...	...	...	...	...	...	...	299
...	...	m. VR.	...	...	...	rs VR	...	s. VR.	...	...	×	...	...	300
...	...	...	...	...	...	...	...	...	...	...	...	...	...	301
...	...	...	...	...	...	...	...	...	...	...	×	...	...	302
...	...	...	...	...	...	...	...	...	...	...	×	...	×	303
...	...	...	...	...	VR.	rs. VR.	...	m. C.	...	RC.	×	...	×	304
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	...	305
...	...	...	...	...	...	...	...	...	...	...	...	...	×	306
...	...	...	...	...	...	...	...	...	s. VR.	...	×	...	...	307

No.	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
308	*Sagrina virgula*, Brady	...	...	...	...	...	...	...	...	...
309	Globigerina bulloides, *d'Orb.*	s. VC.	s. RC.	m. VC.	vs. RC.	s. RC.	s. C.	s. VC.	vs. R.	vs. RC.
310	— Linnæana (*d'Orb.*)	...	vs. VR.	vs. VR.	...	...	...	...	...	...
311	— *æquilateralis*, Brady	...	...	...	...	...	...	...	...	...
312	— *cretacea*, d'Orb	...	...	...	...	...	...	...	...	...
313	— *inflata*, d'Orb.	...	...			...	...	...	...	...
314	— *regularis*, d'Orb.	...	...	...	...	...	...	...	...	...
315	— *triloba*, Reuss	...	...	...	...	...	...	...	...	...
316	Orbulina perforata, *Searles Wood*	...		...	...	...	...	...	...	...
317	— *porosa*, Terquem		...	...		...	...	...	...	...
318	— *tuberculata*, Costa	...			...	...	...	...	...	...
319	— *universa*, d'Orb	...	...	...	...	...	...	...	...	...
320	Pullenia sphæroides (*d'Orb.*)	...	rl. VR	...	...	...	m. VR.	...	m. VR.	...
321	— *quinqueloba*, Reuss	...	...	...	...	...	l. VR.	...	...	...
322	*Sphæroidina bulloides*, d'Orb.	...	...	...	...	...	...	...	...	...
323	Spirillina vivipara, *Ehr.*, including									
324	— — var. minima, *Schacko*	vs. VR.	...	rl. RC.	rs. VR.	...	...	vs. RR.	...	vs. RC.
325	— — var. complanata, *Jones*									
326	— *limbata*, var. *denticulata*, Brady	...	...		...	...	...	...	...	...
327	*Patellina corrugata*, Williamson	...	...	...	...	...	...	...	...	...
328	Discorbina turbo (*d'Orb.*)	m. RC.	s. VR.	...	...	s. VR.	s. VR.	s. VR.	...	...
329	— globularis (*d'Orb.*)	s. VR.	...	...	...	...	...	vs. VR.	...	...
330	— rosacea (*d'Orb.*)	m. RC.	s. R.	s. VR.	vs. VR.	s. RC.	s. R.	vs. VR.	...	vs. VR.
331	— orbicularis (*d'Orb.*)	m. RC.	s. RR.	s. VR.	...	s. RR.	m. C.	vs. VR	vs. VR.	vs. VR.
332	— Parisiensis (*d'Orb.*)	rl. RC.	m. C.	m. RC.	s. C.	s. VR.	rl. VC.	s. RC.	s. VR.	vs. C.
333	— lingulata, *B. & H.*	...	...	...	...	...	rs. VR.	...	...	...
334	— *Araucana* (d'Orb.)	...	...	...	...	...	...	...	...	...
335	— *Bertheloti* (d'Orb.)	...	...	...	...		...	...	...	...
336	— *obtusa* (d'Orb.)	...	...		...	...	...	...	...	...
337	— *patelliformis*, Brady	...	...	...	...	...	...	...	...	...
338	— *pileolus* (d'Orb.)	...	...	...	...	...	...	...		...
339	— *rugosa* (d'Orb.)	...	...	...	...	...	...	...	...	...
340	— *Vilardeboana* (d'Orb.)	...	...	...	...	...	...	...	...	...
341	— *Wrighti*, Brady	...	...	...	...	...	...	...	...	...
342	Planorbulina Mediterranensis (d'Orb.)	...	m. RC.	m. C.	m. RR.	s. RC.	s. RC.	s. RC.	s. VR.	vs. RR
343	Truncatulina refulgens (*Montfort*)	s. VR.	s. RC.	s. R.	...	...	...	...	s. VR.	...
344	— lobatula (*W. & J.*)	rl. C.	m. VC.	l. VC.	m. VC.	s. RC.	m. C.	s. VC.	m. VC.	s. VC.
345	— variabilis (*d'Orb.*)	...	m. RR.	...	m. RR.	s. VR.	m. VR.	s. VR.	s. VR.	...
346	— Haidingeri (*d'Orb.*)	...	...	l. R.	vs. VR.	...	m. RR.	...	m. R.	...
347	— Ungeriana (*d'Orb.*)	s. VC.	m. VC.	m. VC.	vs. VC.	s. RC.	m. C.	s. VC.	s. VC.	vs. RR.
348	— *Akneriana* (d'Orb.)	...	...	...	...	...	...	...	...	...
349	— *Dutemplei* (d'Orb.)	...	...	...	...	...	...	...	...	...
350	— *humilis*, Brady	...	...	...	...	...	...	...	...	...
351	— *Kalembergensis* (d'Orb.)	...	...		...	...	...	...	...	...
352	— *Wuellerstorfi* (Schwager)	...	...	...	...	...	...	...	...	...

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
		Upper Crag.						Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
...	...	...	...	...	...	...	...	...	...	...	...	...	×	308
s. RR.	m. RR.	...	vs. VR.	vs. RC.	C.	s. RR.	vs. RR.	s. RR.	rs. R.	VR.	×	rs. VR	×	309
...	...	...	...	...	...	...	...	...	...	...	...	...	...	310
...	...	...	...	...	...	...	...	...	vs. VR	...	...	vs. VR.	...	311
...	...	...	...	vs. VR.	...	...	...	...	...	...	...	...	...	312
...	...	...	...	rs. R.	...	...	...	...	...	VR.	...	...	...	313
...	...	...	...	...	...	...	...	...	...	...	×	...	...	314
...	...	...	...	...	VR.	...	...	...	...	VR.	...	...	...	315
...	rs. VR.	...	...	...	...	...	...	...	...	...	...	...	...	316
...	...	...	...	...	...	...	...	...	...	...	×	..	...	317
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	318
...	...	...	...	...	VR.	...	...	m. VC.	rs. VR	VC.	×	×	×	319
m. RC.	m. RR.	s. VR.	...	...	...	...	...	m. RC.	s. VR.	...	×	...	×	320
...	...	...	...	...	VR.	rs. VR.	...	...	...	...	...	...	...	321
...	...	...	...	...	VR.	...	...	vs. VR	rs. R	VR	...	rs. VR.	×	322
														323
m. VR.	...	...	...	s. R.	...	vs. VR.	...	...	...	...	...	..	...	324
														325
...	...	...	...	m. RC.	...	...	...	...	...	...	...		...	326
...	...	...	...	s. VC.	...	m. VR.	...	...	...	...	...	...	...	327
...	...	...	...	l. VC.	...	...	...	...	...	...	×	×	...	328
...	...	..	...	s. RR.	.	vs. VR	...	...	...	...	...	...	...	329
...	s. VR.	...	vs. VR.	s. R.	...	s. VR.	s. VR.	.	...	...	...	s. VR.	...	330
...	...	...	..	s. RR.	...	s. VR.	...	rs. R.	m. VR.	..	×	s. VR.	...	331
m. RR.	s. RC.	s. R.	...	l. VC.	...	vs. VR.	vs. VR.	...	...	...	...	...	...	332
...	...	...	...	m. RC.	...	...	...	..	...	...	...	...	...	333
...	...	...	...	m. RR.	...	...	...	...	...		...	...	...	334
...	...	...	...	m. R.	...	...	...	...	...	...	...	rs. VR.	...	335
...	...	...	...	...	...	...	vs. VR.	...	...	...	...	...	...	336
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	337
...	...	...	...	...	...	s. VR.	s. VR.	...	...	VR.	...	...	...	338
...	...	...	...	...	...	...	...	rs. R.	s. VR.	VR.	...	...	...	339
...	...	...	...	...	...	...	...	...	s. VR.	...	...	...	×	340
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	341
m. RR.	...	...	m. VR.	m. VR.	...	vs. VR.	vs. VR.	s. VR.	...	...	...	...	...	342
...	...	m. R.	...	...	...	..	s. VR.	...	...	...	...	...	...	343
s. VC.	m. C.	s. C.	m. RC.	s. VC.	C.	s. C.	s. RR.	s. RC.	rs. RR.	RC.	...	m. RC.	...	344
...	...	...	...	s. RR.	...	rs. VR.	...	...	...	...	...	rs. VR.	...	345
m. C.	s. R.	...	...	vs. VR.	. .	...	vs. R.	m. VR.	rs. VR.	RC.	...	m. RR.	×	346
m. C.	...	...	...	s. RC.	...	rs. RR.	vs. VR.	rs. VR.	m. R.	RC.	×	vs. VR.	×	347
...	...	...	...	m. RR.	...	s. RR.	...	...	...	VR.	...	...	...	348
...	...	...	...	...	...	...	...	...	...	VR.	...	...	×	349
...	...	...	...	...	...	s. VR.	...	...	...	...	...	..	...	350
...	...	...	...	...	VR.	...	..	...	...	...	...	...	...	351
...	...	...	...	...	...	rs. VR.	...	...	...	...	...	.	...	352

	Genera, Species, and Varieties.	English								
		Coralline Crag.								
		Zone **d.**			Zone **e.**		Zone **f.**		Zone **g.**	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
353	*Truncatulina præcincta* (Karrer)	...	...	...	...	...	...	...	...	...
354	— *pygmæa*, Hantken	...	...	...	...	...	...	...	...	...
355	— *reticulata* (Czjzek)	...	...	...	...	...	...	...	...	...
356	— *tenuimargo*, Brady	...	...	...	...	...	...	...	...	...
357	Anomalina grosserugosa (*Gümbel*)	...	m. VR.	...	...	...	...	...	...	...
358	— *ammonoides* (Reuss)		...	...	...	...	...	...	...	...
359	— *Ariminensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
360	Pulvinulina repanda (*F. & M.*)	vs. VR.	m. RC.	rs. R.	m. C.	...	m. VR.	m. C.	s. VR.	vs. VR.
361	— — var. *concamerata* (Montagu)	...	...	...	...	...	...	...	...	...
362	— punctulata (*d'Orb.*)	...	l. RR.	l. RR.	...	...	s. RR.	m. C.	rl. RC.	vs. VR.
363	— auricula (*F. & M.*)	s. VR.	m. VR.	...	...	...	s. VR.	s. VR.	...	...
364	— Karsteni (*Reuss*)	s. VR.	...	...	...	...	...	...	...	...
365	— elegans (*d'Orb.*)	vs. VR.	m. VR.	...	...	s. VR.	...	...	vs. VR.	...
366	— Berthelotiana (*d'Orb.*)	...	...	...	rs. VR.	...	...	...	...	...
367	— *Canariensis* (d'Orb.)	...	...	...	...	...	...	...	...	...
368	— *crassa* (d'Orb.)	...		...	...	...	...	...	...	...
369	— *Hauerii* (d'Orb.)	...		...	...	...	...	...	...	...
370	— *nitidula*, Chaster	...		...	...	...	...	...	...	...
371	— *oblonga* (Williamson)	...	...	...	...	...	...	...	...	...
372	— *Partschiana* (d'Orb.)	...	...	...	...	...	...	...	...	...
373	— *Patagonica* (d'Orb)	...	...	...	...	...	...	...	...	...
374	— *procera*, Brady	...	...	...	...	...	...	...	...	...
375	— *Schreibersii* (d'Orb.)		...	...	...	...	...	...	...	...
376	— *umbonata*, Reuss	...	...	...	...	...	...	...	...	...
377	Rotalia Beccarii (*Linné*)	rl. VC.	rl. RC.	l. RC.	m. VC.	m. R.	rs. C.	rl. VC.	rl. RR.	vs. RC.
378	— orbicularis, *d'Orb.*	...	...	s. VR.	...	s. VR.	s. VR.	...	...	...
379	— calcar (*d'Orb.*)	vs. VR.	...	m. VC.	s. C.	s. RC.	rl. RR.	s. VC.	m. VC.	vs. RC.
380	— *dentata*, P. & J.	...	...	...	...	...	...	...	...	...
381	— (*Discorbina*, Wr.) *nitida* (Will.)	...	...	...	...	...	...	...	...	...
382	— *punctato-granulosa*, Seguenza	...	...	...	...	...	...	...	...	...
383	— *Soldanii* (d'Orb.)	...	...	...	...	...	...	...	...	...
384	Gypsina vesicularis (*P. & J.*)	...	...	...	...	...	...	...	...	...
385	Nonionina scapha (*F. & M.*), including	m. C.	m. VC.	m. VC.	m. RC.	m. C.	l. VC.	m. VC.	m. RC.	m. C.
386	— — var. *labradorica*, Dawson									
387	— Boueana (*d'Orb.*)		...	...	...	...	...	...	...	...
388	— — var. Janiformis, *Jones*	...	...	...	...	...	l. VR.	...	...	...
389	— umbilicatula (*Montagu*)	...	...	...	vs. VR.	vs. VR.	s. R.	...	...	...
390	— depressula (*W. & J.*)	s. VR.	s. RC.	...	rs. VR.	...	...	vs. VR.	...	vs. VR.
391	— *affinis*, Reuss	...	...	...	...	...	...	...	...	...
392	— *communis*, d'Orb	...	...	...	...	...	...	...	...	...
393	— *pompilioides* (F. & M.)	...	...	...	...	...	...	...	...	...
394	— *stelligera*, d'Orb	...	...	...	...	...	...	...	...	...
395	— *turgida* (Williamson)	...	...	...	...	...	...	...	...	...
396	Polystomella faba (*F. & M.*)	...	...	...	...	...	...	...	...	...
397	— striato-punctata (*F. & M.*)	s. VR.	s. RC.	...	s. RC.	...	s. RR.	s. C.	s. VR.	vs. RR.

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
Zones undetermined.		Upper Crag.						Plaisancian.				Astian.		
Sutton. 10	Sudbourne, Gedgrave, Aldborough, &c. 11	Red Crag. 12	Beds above Red Crag. 13	St. Erth Beds. 14	Diestian. 15	Casterlian. 16	Scaldisian. 17	Bordighera. 18	Albenga. 19	Trinité Victor. 20	Piedmont. 21	Monte Pellegrino, &c. 22	Garrucha (S. Spain). 23	
...	...	...	...	...	...	...	...	...	...	C.	...	...	×	353
...	...	...	...	rs. R.	...	...	...	...	...	...	...	...	×	354
...	...	...	...	...	...	...	...	...	...	...	...	...	×	355
...	...	...	...	s. RR.	VR.	...	...	...	...	...	...	...	...	356
...	...	...	...	...	...	s. VR.	...	m. RR.	vs. VR.	VR.	...	...	...	357
...	...	...	...	...	...	...	vs. VR.	...	...	RR.	...	...	×	358
...	...	...	...	...	...	...	...	...	rl. R.	...	...	...	×	359
vl. RC.	m. R.	...	...	...	...	vs. VR.	...	...	...	...	...	...	...	360
...	...	...	...	...	...	...	...	...	m. VR.	...	×	×	...	361
vl. C.	...	...	...	...	...	...	...	...	...	...	...	...	...	362
m. R.	...	...	...	s. R.	VC.	...	vs. VR.	rs. RR.	rs. VR.	...	...	...	×	363
...	...	...	s. R.	rs. RC.	...	rs. VC.	vs. RC.	...	...	VR.	...	...	...	364
l. VR.	...	...	...	s. R.	...	...	s. VR.	l. RC.	vs. VR	VC.	...	rs. VR.	...	365
...	...	...	...	...	...	...	...	m. RC.	rl. VC.	R.	...	...	...	366
...	...	...	...	s. VR.	...	...	...	s. VR.	...	...	...	...	...	367
...	...	...	...	rs. VR.	...	...	...	...	...	...	...	...	...	368
...	...	...	...	m. VC.	...	...	...	...	...	...	...	...	...	369
...	...	...	...	m. R.	...	...	...	...	...	...	...	...	...	370
...	...	...	...	s. VR.	...	...	...	...	...	VR.	×	...	...	371
...	...	...	...	...	...	...	...	...	...	...	...	...	×	372
...	...	...	...	...	...	...	...	...	...	...	×	...	...	373
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	374
...	...	...	...	...	...	...	...	...	...	VC.	...	...	×	375
...	...	...	...	...	...	...	...	...	s. VR.	...	×	...	×	376
s. RC.	m. C.	m. C.	m. C.	l. C.	...	m. C.	rl. C.	rs. VR.	m. C.	RC.	...	m. RC	...	377
s. R.	...	...	...	rs. R.	VR.	...	...	...	vs. VR.	...	...	...	...	378
s. RR.	m. C.	s. R.	...	s. C.	...	vs. VR.	vs. VR	...	...	...	...	...	...	379
...	...	...	...	s. VR.	...	...	...	...	...	...	...	...	...	380
...	...	...	...	m. RC.	...	...	...	...	...	...	...	...	...	381
...	...	...	...	vl. C.	...	...	...	...	...	...	...	...	...	382
...	...	...	...	...	...	...	...	rs. VR.	...	...	×	...	×	383
...	m. VR.	...	...	...	...	...	...	...	...	...	...	...	...	384
l. VC.	l. C.	s. R.	...	s. RC.	...	s. VR.	rs. RC.	s. RC.	rs. VR.	VR.	...	...	...	385, 386
...	...	...	...	...	VC.	vs. RR.	s. VR.	...	...	...	×	...	...	387
...	l. C.	...	...	...	...	vs. VR.	...	...	...	...	...	...	...	388
s. RR.	...	...	...	s. R.	...	...	...	rs. C.	vs. VR.	VR.	...	...	×	389
s. R.	...	...	...	m. R.	...	s. VR.	...	...	...	...	...	...	...	390
...	...	...	...	...	C.	...	...	...	...	...	...	...	...	391
...	...	...	...	s. R.	...	...	...	...	...	...	×	...	...	392
...	...	...	...	...	...	...	...	...	...	VR.	×	...	×	393
...	...	...	...	s. R.	...	...	...	...	...	...	...	...	...	394
...	...	...	...	...	VR.	...	...	...	s. VR.	...	...	...	...	395
m. RC.	l. R.	l. VR.	...	...	...	...	...	...	...	...	...	...	...	396
s. R.	m. C.	s. C.	m. VC.	m. RC.	...	s. VC.	rs. VC.	...	...	...	...	...	...	397

	Genera, Species, and Varieties.	English Coralline Crag. Zone d.			Zone e.		Zone f.		Zone g.	
		Tattingstone. 1	Sudbourne Hall. 2	Broom Hill. 3	Broom Hill. 4	Sutton. 5	Sutton. 6	Gedgrave. 7	Aldborough. 8	Gedgrave. 9
398	Polystomella crispa (*Linné*)	l. VR.	rs. C.	l. VC.	rl. VC.	m RC.	rl. C.	s. VC.	s. RR.	vs. RC.
399	— macella (*F. and M.*)	s. VC.	s. VC.	l. C.	rs. VC.	m. R.	rl. R.	s. VC.	s. VR.	vs. RC.
400	— *Josephina*, d'Orb.	...	...	...		...	...	...	...	...
401	— *subnodosa* (Münster)		...	...		...	...	...	...	...
402	*Faujasina carinata*, d'Orb.	...			...	...	...	...	...	...
403	— *Orbignyi*, Terquem	...	...	...	...		...		...	...
404	Amphistegina vulgaris, *d'Orb.*		...	...	...		...	...	...	...
405	Operculina complanata, *Defrance*	...	...	...	...	...	...	...	...	...
406	— ammonoides (*Gronovius*)	...	...	vs. VR.	...	...	...	vs. VR.	...	...
407	— — var. curvicamerata, *Jones*	...	...	...	...	...	...	...	...	...
408	*Heterostegina depressa*, d'Orb.	...	...	...	...		...	...	...	...
409	Nummulites Boucheri, *de la Harpe*	...	...						...	...
410	Orbitoides aspera, *Gümbel*			...	...	...			...	...

In the foregoing Table those species which occur in the Crag Beds of East Anglia, as described in the Monograph, are printed in ordinary type. The species which have not been found in the Crag, but which occur in the St. Erth Beds, or in other Pliocene Formations of Europe, are printed in *italics*. It will be noticed that additional occurrences are recorded in the Table for some of the Crag Species. These have been met with since the earlier pages were printed off.

The information contained in the Table is based upon our own work, supplemented in some instances, as mentioned below, by published records.

Coralline Crag.—The records for the distribution of Foraminifera in the zones of the Coralline Crag are the result of our examination of material specially collected by ourselves at various times from the several zones now open, and at the sections described in the earlier part of this Monograph. The only exception is the Tattingstone material. This was given to us by the late Sir Joseph Prestwich; and we had further the kind assistance of Mr. Frederic Chapman with respect to that particular locality.

The Columns for the "Zones undetermined" are summarised from the Table given in Appendix II of the First Part of this Monograph, with the addition of a few species described in the later parts of the Monograph, and of which it is now impossible to ascertain the exact zone whence they were derived.

Red Crag and Beds above the Red Crag.—With the few unimportant additions already recorded at p. 78, the original list of Foraminifera from the Red Crag and the Beds above it remains the same as in the Table already referred to.

Pliocene.					Belgian Pliocene.			Italian Pliocene.					Spanish Pliocene.	
		Upper Crag.						Plaisancian.				Astian.		
Zones undetermined.														
Sutton.	Sudbourne, Gedgrave, Aldborough, &c.	Red Crag.	Beds above Red Crag.	St. Erth Beds.	Diestian.	Casterlian.	Scaldisian.	Bordighera.	Albenga.	Trinité Victor.	Piedmont.	Monte Pellegrino, &c.	Garrucha (S. Spain).	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	
m. RC.	m. RC.	m. R.	s. R.	m. C.	...	...	m. VC.	rl. RR.	rl. VC.	C.	×	m. VC.	×	398
m. RR.	m. C.	...	...	l. VC.	...	vs. VR.	s. VR	s. VR.	...	...	...	rs. VR.	...	399
...	...	...	...	...	...	...	...	...	...	...	...	...	×	400
...	...	...	...	rs. RC.	...	...	...	...	...	...	...	...	...	401
...	...	...	...	l. VC.	...	...	..	...	...	...	...	...	...	402
...	...	...	...	l. RR.	...	...	...	...	...	...	...	...	...	403
×	× ?	...	...	s. VR.	...	vs. VR.	...	l. VC.	s. VR.	VR.	×	×	...	404
...	× ?	...	...	...	...	...	...	...	...	VR.	...	...	...	405
...	...	...	...	...	...	...	...	...	...	...	...	...	...	406
s. VR.	...	...	...	...	...	...	...	...	...	...	...	...	...	407
...	...	...	...	...	...	...	...	...	...	VR.	...	...	...	408
...	× ?	...	...	...	...	s. VR.	...	...	...	...	...	...	...	409
...	× ?	...	...	...	...	...	...	...	...	...	...	...	...	410

St. Erth Beds.—The column referring to the St. Erth Beds is prepared from the lists published by Mr. Fortescue W. Millett in his papers (1885, 1894, &c.) already quoted (*antea*, p. 80), supplemented by notes of additional species kindly supplied to us by Mr. Millett, who has further added to our obligations to him by very kindly furnishing the records of "size" and "frequency" of the species met with in this rich deposit. Mr. Millett wishes us to state that, although *Lagena Lyellii* remains in the St. Erth list in this Table, he is of opinion that it should probably be omitted as not being a good "species."

Belgian Pliocene.—The records for the Scaldisian and Casterlian Beds are the result of our examination of material selected by one of us in company with M. E. Vanden Broeck during the summer of 1886, at which time the excavations for the dry docks at Kattendyk, Antwerp, were in progress. The Scaldisian fossiliferous beds were divided by M. Vanden Broeck into two principal bands, a "banc coquillier inférieur" and a "banc coquillier supérieur." The difference between the Foraminifera obtained from these bands is inconsiderable, and we have therefore given but one column for the two bands.

The Diestian (of Edeghem) list is prepared from that published by M. Mourlon ('Géol. de la Belgique (1880), vol. ii, pp. 235 *et seq.*). The list is an old one founded on that by H. Nyst in Dewalque's 'Prodrome d'une description géol. de la Belgique' (1868), which again appears to be based upon Reuss's work on the Crag of Antwerp. We have carefully examined the published figures and descriptions, and have referred the species recorded to their synonymic position wherever practicable. A few still included in the list under the names given by Reuss are doubtful species.

Italian Pliocene.—The Foraminifera of the Plaisancian Beds of Bordighera and Albenga, here recorded for the first time, were obtained from material kindly supplied to us by Mr. Edward

E. Berry, of Bordighera. For the other Italian records we have laid under contribution the list published by Prof. F. Sacco ('Il Bacino Terziario e Quaternario del Piemonte,' 1889, pp. 24—33) for the Plaisancian Beds of Piedmont; but, as that list records "occurrences" merely, we are unable to give any account of the "size" and "frequency" of the specimens. The Plaisancian Beds of Trinité-Victor are ably dealt with by Dr. de Amicis ("I foraminiferi del Pliocene Inf. di Trinité-Victor," 'Boll. Soc. Geol. Ital.,' vol. xii, 1893, fasc. 3, pp. 293 *et seq.*), and the list given is taken from that work. In his Table Dr. de Amicis records always the number of specimens; and in the text, for some of the species, if not for all, the size of the specimens is recorded in millimètres. This rigidly exact method of noting size has unfortunately not been generally adopted, and we have excused ourselves the labour of picking out the information from the text for the purposes of this Table, because general symbols are used in the rest of the columns.

The Astian list is based principally upon an examination of some material in our own collections from Monte Pellegrino, supplemented by the records of a few species given by Prof. Sacco in the work already referred to. Prof. Sacco's list, however, is meagre, fourteen species only being therein recorded.

In some few cases our Table does not contain a note of the occurrence of some Italian Pliocene species, which are referred to in the notes on "Occurrences" given in the text of the Monograph. Such omissions from the Table are due to the fact that the exact horizon in those cases is not known to us.

Spanish Pliocene.—The list of species met with in the Pliocene Beds of Garrucha, South Spain, is prepared from the list appended to the paper on the fauna of that locality by Dr. Franz Schrodt ('Zeitschr. d. D. Geol. Ges.,' vol. xlii, 1890, pp. 386 *et seq.*).

INDEX.

Synonyms are printed in italics.

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CRAG
FORAMINIFERA.

PART I, No. I.

By
T. R. Jones,
W. K. Parker,
and
H. B. Brady.